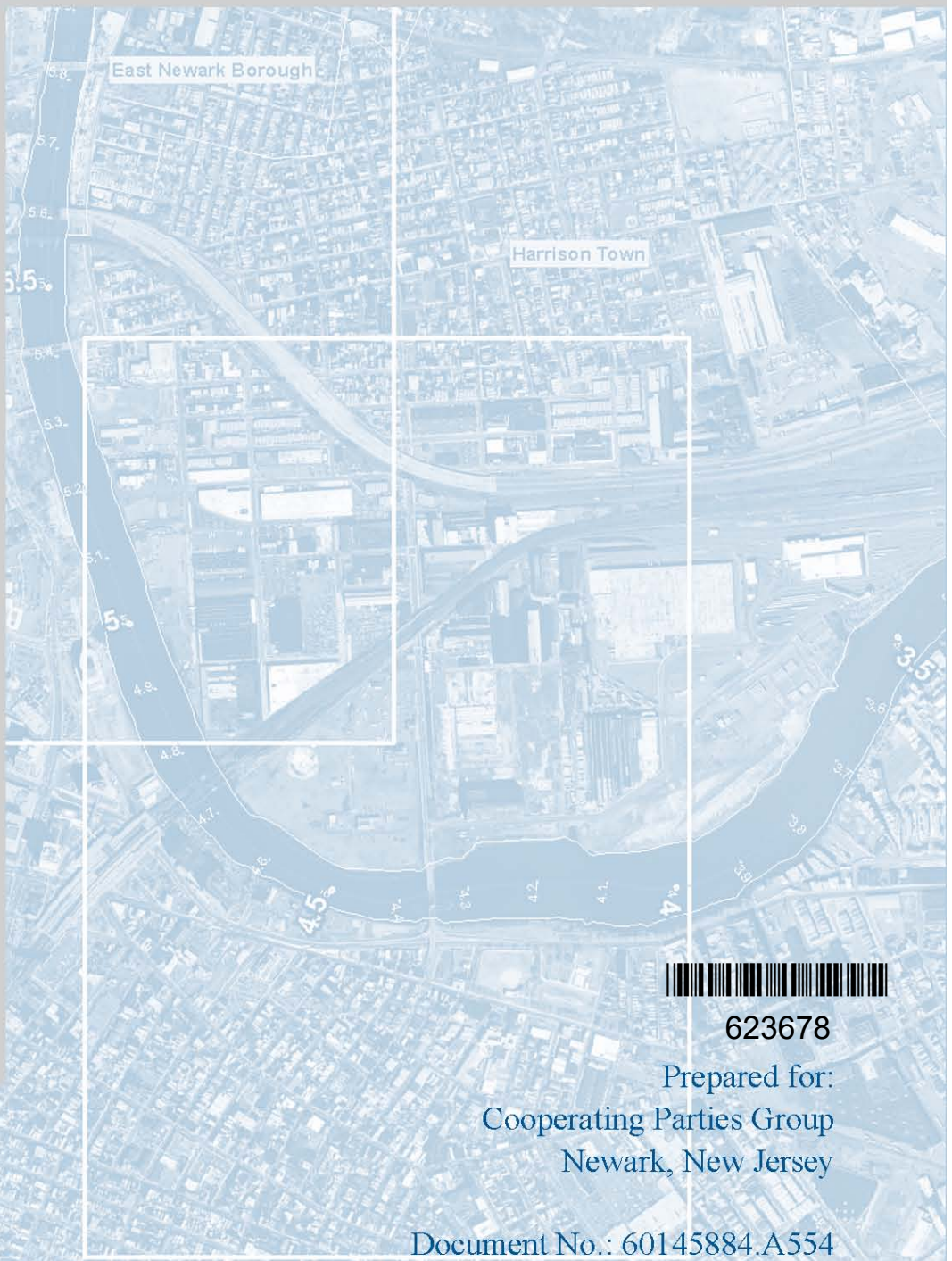
Quality Assurance Project Plan
Lower Passaic River Restoration Project

Quality Assurance Project Plan/Field Sampling Plan Addendum

RI Water Column Monitoring/Small Volume Chemical Data Collection

Revision 3, July 2012



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Quality Assurance Project Plan/Field Sampling Plan Addendum

Remedial Investigation Water Column Monitoring/Small Volume Chemical Data Collection

Lower Passaic River Restoration Project

July 2012

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Contents

List of Acronyms

Acronym	Definition
%D	Percent Deviation
ADCP	Acoustic Doppler Current Profiler
ARAR	Applicable, Relevant or Appropriate Requirements
BCS_3	Batch Control Spike
BFB	Bromofluorobenzene
BOD	Biological Oxygen Demand
Br	Bromine
C	Celsius
CA	Corrective Action
CARP	Contaminant Assessment Reduction Program
CAS Number	Chemical Abstract Services Number
CAS	Columbia Analytical Services
CCB	Continuing Calibration Blank
CCV	Continuing Calibration Verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	Cubic Feet per Second
CFT	Chemical Fate and Transport
CFU	Colony Forming Unit
Cl	Chlorine
COC	Chain-of-Custody
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
CPG	Cooperating Parties Group
CPR	Cardiopulmonary Resuscitation
CRM	Certified Reference Material
CSM	Conceptual Site Model
CSO	Combined Sewer Overflow
Cu	Copper
CVAFS	Cold Vapor Atomic Fluorescence
CWCM	Chemical Water Column Monitoring
ddms	de maximis Data Management Solutions, Inc.
DFTPP	Decafluorotriphenylphosphine
dGPS	Differential Global Positioning System
DMP	Data Management Plan
DOC	Dissolved Organic Carbon
DOT	Department of Transportation
DQI	Data Quality Indicators
DQO	Data Quality Objective

List of Acronyms (Continued)

Acronym	Definition
DUO	Data Use Objective
DVR	Data Validation Report
E. Coli	*Escherichia coli*
ECD	Electron Capture Detector
EDD	Electronic Data Deliverable
EDP	Electronic Data Processor
EHS	Environmental Health and Safety
EMBM	Empirical Mass Balance Model
EDL	Estimated Detection Limit
EML	Estimated Minimum Level
EMSL	Environmental Molecular Sciences Laboratory
EPA	Environmental Protection Agency
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
FID	Flame Ionization Detector
FPD	Flame Photoionization Detector
FS	Feasibility Study
FSP	Field Sampling Plan
ft	Foot (Feet)
FTM	Field Team Manager
FWM	Food Web Model
GC	Gas Chromatography
GC/MS	Gas Chromatography-Mass Spectrometry
GEL	General Engineering Laboratories
GPC	Gel Permeation Cleanup
GPS	Global Positioning System
H_2SO_4	Sulfuric Acid
HASP	Health and Safety Plan
HAZMAT	Hazardous Materials
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCl	Hydrochloric acid
HHRA	Human Health Risk Assessment
HOC	Hydrophobic Organic Constituents
HPLC	High Pressure Liquid Chromatography
HRGC	High Resolution Gas Chromatography
HRMS	High Resolution Mass Spectrometry
HSL	Hazardous Substances List
HSMVS	HOC Sampling Method Validation Study
IC	Ion Chromatography

List of Acronyms (Continued)

Acronym	Definition
ICAL	Initial Calibration
ICP	Inductively Coupled Plasma
ICS	Interference Check Sample
ICP/AES	Inductively Coupled Plasma Atomic Emission Spectroscopy
ICV	Initial Calibration Verification
IDW	Investigation-Derived Wastes
IEC	Inter Element Corrections
IPR	Internal Precision and Recovery
K&L Gates	Kirkpatrick and Lockhart Preston Gates Ellis LLP
L	Liter
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LFB	Laboratory Fortified Blank
LIMS	Laboratory Information Management System
LOC	Level of Chlorination
LPR	Lower Passaic River
LPRRP	Lower Passaic River Restoration Project
LPRSA	Lower Passaic River Study Area
LRMS	Low Resolution Mass Spectrometry
M	Molar
MB	Method Blank
MDL	Method Detection Limit
MEDD	Multi-media Electronic Data Deliverable
mg/L	Milligrams per Liter
min	Minute
mL	Milliliter
ML	Minimum Level
Mn	Manganese
mo	Month
MPI	Malcolm Pirnie, Inc.
mS/cm	Micro Siemens per centimeter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	Not Applicable
NaOH	Sodium Hydroxide
NB	Newark Bay
NBSA	Newark Bay Study Area
ng/L	Nanograms per Liter
ND	Not Detected

List of Acronyms (Continued)

Acronym	Definition
NH3	Ammonia
NIST	National Institute of Standards and Technology
NJDEP	New Jersey Department of Environmental Protection
NJDOT	New Jersey Department of Transportation
NOAA	National Oceanic and Atmospheric Administration
NS	No Standard
NY	New York
NY/NJ HEP	New York-New Jersey Harbor Estuary Program
OC	Organochlorine
OPR	On-going Precision and Recovery
OSI	Ocean Surveys, Inc.
OU	Operable Unit
P&T	Purge and Trap
PAH	Polycyclic Aromatic Hydrocarbons
PAL	Project Action Limit
PCB	Polychlorinated Biphenyl
PCDD	Polychlorinated Dibenzo-p-dioxin
PCDF	Polychlorinated Dibenzofuran
PE	Performance Evaluation
PFD	Problem Formulation Document
PFK	Perfluorokerosene
pH	Potential Hydrogen
PID	Photoionization Detector
PM	Project Manager
POC	Particulate Organic Carbon
ppth	Part per Thousand
PQO	Project Quality Objectives
PREmis	Passaic River Estuary Management Information System
PRP	Potentially Responsible Party
PTFE	Polytetrafluoroethylene
PT/PE	Performance Testing/ Performance Evaluation
PWCM	Physical Water Column Monitoring
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QCCS	Quality Control Check Sample
QL	Quantitation Limit
QMP	Quality Management Plan
RA	Risk Assessment

List of Acronyms (Continued)

Acronym	Definition
RCL	Recovery Control Limits
RF	Response Factors
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RL	Reporting Limit
RM	River Mile
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RRF	Relative Response Factors
RSD	Relative Standard Deviation
S&A	Sampling and Analytical
S/N	Signal to Noise
SAIC	Science Applications International Corporation
SDG	Sample Delivery Group
SIM	Selective Ion Monitoring
SOP	Standard Operating Procedure
SOW	Statement of Work
SPCC	System Performance Check Compounds
SRM	Standard Reference Materials
SSC	Suspended Solids Concentration
SSO	Site Safety Officer
SVCG	Small Volume Composite Grab
SVOC	Semi-Volatile Organic Compound
SWO	Stormwater Outfall
TAL	Target Analyte List
TC	Technical Committee
TCL	Target Compound List
TDS	Total Dissolved Solids
TIC	Tentatively Identified Compound
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
TSA	Technical Surveillance Audit
VER	Calibration Verification
VOA	Volatile Organics Analysis
VOC	Volatile Organic Compound
UCL	Upper Confidence Limit
ug/L	Microgram per Liter

List of Acronyms (Continued)

Acronym	Definition
UFP	Uniform Federal Policy
um	Micron
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Service
UV-VIS	Ultraviolet-Visible Spectrophotometry
v/v	Volume to Volume
WCM	Water Column Monitoring

Introduction

This Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) Addendum detail the proposed execution of a portion of the Water Column Monitoring (WCM) Program of the Remedial Investigation (RI) as outlined in the Lower Passaic River Restoration Project (LPRRP) FSP, Volume 1 (Malcolm Pirnie, Inc. (MPI) 2006). The RI is required by the Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study (RI/FS) (Settlement Agreement [USEPA 2007a] and its Appendix B (i.e., Statement of Work [SOW]). The Cooperating Parties Group (CPG), which included 73 Potentially Responsible Parties (PRPs), has entered into the Settlement Agreement (USEPA 2007a) to perform the RI. This document uses applicable worksheets from the United States Environmental Protection Agency (USEPA) Uniform Federal Policy (UFP) on QAPPs [Publication Numbers: EPA: EPA-505-B-04-900A DoD: DTIC ADA 427785] (USEPA 2005). This document includes both the QAPP and the FSP Addendum, which is included as Appendix A. Appendix B contains the field standard operating procedures (SOPs) and Appendix C contains the laboratory SOPs.

The WCM program has been divided into two subtasks. One subtask, the WCM/Physical Data Collection or Physical WCM (PWCM) program, includes collection of physical measurements in the water column (currents, temperature, conductivity, turbidity, organic carbon and solids). This subtask has been performed under the *Quality Assurance Project Plan/Field Sampling Plan Addendum, Remedial Investigation Water Column Monitoring/Physical Data Collection for the Lower Passaic River, Newark Bay and Wet Weather Monitoring, Lower Passaic River Restoration Project* (AECOM 2010a). The other subtask, WCM/Chemical Data Collection or Chemical Water Column Monitoring (CWCM), a portion of which is addressed in this QAPP, includes collection of water column samples for chemical analysis. The portion of the CWCM data collection described in this QAPP covers the small volume sampling phase of the subtask; a high volume sampling phase is currently being planned and will be proposed as a separate QAPP/FSP Addendum. The information collected with respect to the physical characteristics of the Lower Passaic River (LPR) has been used to aid in the development of the FSP for this phase of the CWCM program.

The proposed investigation includes the collection of small volumes of water (i.e., consistent with SW-846 and other federal and state methods) for analysis of the target analytes in whole water, with a subset of metals and organic carbon analyzed in the dissolved phase. All proposed analyses have been assigned to one of four groups described in the following paragraphs:

Group A - A list of target physical, and inorganic and organic chemical analyses is proposed for the full set of events, stations and depths (refer to Worksheet #15). These analytes will be measured in all samples during each of the eight events and will be used primarily for estimation of exposure point concentrations (EPCs) for the human health risk assessment (HHRA), ecological risk assessment (ERA) and food web model (FWM), and in the calibration of the chemical fate and transport (CFT) model. This analyte list is consistent with the Modeling Work Plan (HydroQual, 2006) and includes polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDD/PCDFs), polychlorinated biphenyl (PCB) congeners and homologs, and mercury (total and dissolved). Total and dissolved cadmium, copper and lead will also be included in the Group A list. Supporting parameters to be used in the CFT model (i.e., dissolved organic carbon (DOC), particulate organic carbon (POC), suspended solids concentration (SSC), total organic carbon (TOC), chlorophyll a, alkalinity, sulfate, total sulfide, total dissolved solids (TDS), and chloride) are also included.

Group B - A comprehensive list of physical, and inorganic and organic chemical analyses is proposed for the full set of stations and depths for a subset of sampling events (refer to Worksheet #15). These parameters will be used to support EPC calculations for the HHRA, ERA and FWM, as well as

validation of the CFT model, and include target compound list (TCL) semivolatile organic compounds (SVOCs), TCL volatile organic compounds (VOCs), target analyte list (TAL) metals, a subset of TAL metals in dissolved phase (arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc), titanium, methyl mercury (total and dissolved), hexavalent chromium (dissolved only), butyltins, organochlorine (OC) pesticides, cyanide, polycyclic aromatic hydrocarbons (PAHs), alkyl PAHs, hardness (calculated), total Kjeldahl nitrogen (TKN), ammonia and total phosphorus. Tentatively identified compounds (TICs) will be reported in association with the TCL VOC and SVOC analyses.

Group C - Pathogen analyses are proposed for near-surface samples during one tidal phase or hydrograph stage from five stations in RM 0 - 17.4 of the LPR to determine their relevance in future investigation phases. The five stations, shown in Worksheet #18, were selected by reviewing the sample maps to ensure coverage within the full length of the river, with a focus on areas where combined sewer overflows (CSOs) are present and to provide information regarding the input of pathogens during storm events from off-site sources. Group C will be sampled during spring and summer routine events, the low flow/spring tide event, and both high flow events and includes total coliform and *Escherichia coli* (*E. coli*), fecal coliform, fecal streptococci and fecal enterococci bacteria. Analysis of Group C parameters will be conducted outside the RI/FS Trust for the LPRSA.

Group D - Additional pathogen analyses are proposed for near-surface samples during one tidal phase or hydrograph stage from the five stations in the LPR (RM 0 - 17.4) to determine their relevance in future investigation phases. Group D includes the protozoans *Giardia* and cryptosporidium, and will be sampled during summer routine events and both high flow events. Analysis of Group D parameters will be conducted outside the RI/FS Trust for the LPRSA.

Specific stations designated for the additional Group C and D analyses are identified in Worksheet #18.

The collection of these water samples occur over the course of eight planned sampling events. The events are described below and summarized in Table 1. The flow thresholds for the low flow and high flow events were selected from an analysis of the discharge record at Dundee Dam (April 2007 to August 2010). The low flow event threshold was identified by conducting an analysis of the number of events satisfying both the discharge criterion and the spring-tide criterion. The analysis showed that a discharge criterion of <400 cubic feet per second (cfs) was satisfied multiple times (i.e., 8-12 times per calendar years 2007-2009) in each of the years over the period of record at Dundee Dam.

The high flow threshold was identified by conducting a return frequency analysis using the available discharge data at Dundee Dam. A flow event with a return period of 3 months (or 4 occurrences per year) was chosen as the flow threshold that can reasonably be expected to be exceeded during the CWCM period. Accordingly, the discharge associated with the 1 in 3 months event at Dundee Dam was calculated to be 3,000 cfs and is proposed as the minimum flow for a high flow event.

- **Routine Events** – Five Routine Events are planned over the course of approximately one year under normal flow conditions (400 - 3,000 cfs at the gage at Dundee Dam). The five events are planned to occur in winter (one event), spring (two events) and summer (two events). At least one Routine Event will occur under spring tide conditions and one under neap tide conditions. The sample locations will include the Lower Passaic River Study Area (LPRSA) (the lower 17.4 miles of the Passaic River and its tributaries), above Dundee Dam, and the Newark Bay Study Area (NBSA), which is defined as including Newark Bay and its confluences with the Hackensack River, Arthur Kill and Kill van Kull (Worksheet #18). The data collected during the Routine Events will support the exposure point calculations for the risk assessments (RAs) and FWM. The Routine Events are planned to occur under several different

flows, ranging from 400 - 3,000 cfs at Dundee Dam. These events are designed to provide information regarding the variability of chemical concentrations in the study area to support the calibration and validation of the CFT model. It is anticipated that the Routine Events will capture data representative of the normal influxes and mixing processes in the river and the bay, the deposition of particulates from the water column to the sediment, and of the preliminary diffusive flux of contaminants from the sediments to the water column. One hundred eight (108) samples will be collected during each of the Routine Events to be analyzed for target analytes as defined in Worksheet #15. Group A analytes will be sampled in each event. Group B analytes will be measured in one spring and two summer events. Shallow (3 feet (ft) below surface) water stations in the five locations in the lower 17.4 miles of the LPR will be analyzed for pathogens (Groups C and D - Worksheet #15 and #18). Group C analytes (coliform bacteria) will be analyzed in the two spring and two summer events; and Group D analytes (Giardia and cryptosporidium) will be sampled during the summer events. Frequency and type of QC samples are provided in Worksheet #20.

- **High Flow Events** – Two High Flow Events are planned under storm-induced high flow (i.e., not sustained high flow) conditions (>3,000 cfs at Dundee Dam). The planned sample locations include the LPRSA, above Dundee Dam, and NBSA (Worksheet #18). The data collected during the High Flow Events will be used to support the exposure point calculations for the RAs and FWM. The data will also be used to support the preliminary calibration and validation of the CFT model (e.g., the resuspended flux from the sediments to the water column, and the subsequent deposition of particle-bound contaminants from the water column to the sediment). It is also anticipated that during these events there will be a higher loading of suspended sediments (i.e., more contamination on a per unit weight suspended solids basis may occur since elevated flows associated with storm events will resuspend more bed sediment). These data will be used in conjunction with CSO and storm water outfall (SWO) data being collected by Tierra Solutions, Inc. (Tierra Solutions, Inc. 2011) to estimate loading using the Passaic Valley Sewer Commissioner's Storm Water Management Model (SWMM) or empirical loading calculations, and for contaminant source identification. The CSO and SWO data to be collected by Tierra are being analyzed using analytical techniques, described in the CSO/SWO QAPP (Tierra Solutions, Inc. 2011), that are different from those being implemented in the small volume CWCM QAPP and may include larger volumes of water for some analytes. However, differences in the analytical method will not negate the usefulness of combining these data. The SWMM will be used to calibrate and validate the external inputs to the system in the CFT model. One hundred fourteen (114) samples will be collected during each of the High Flow Events to be analyzed for target analytes as defined in Worksheet #15. Group A analytes will be measured during both events. Group B analytes will be measured in one of the two events. Shallow (3 ft below surface) water stations in the five locations in the LPR (RM 0 – 17.4) will be analyzed for pathogens (Worksheet #15 and #18). Group C analytes (coliform bacteria) and Group D analytes (*Giardia* and cryptosporidium) will be sampled during both events. Frequency and type of QC samples are provided in Worksheet #20.
- **Low Flow/Spring Tide Event** – One event is planned under low flow conditions (<400 cfs at Dundee Dam) during a spring tide in order to capture data representative of periods with greatest tidal mixing. With this discharge, the salt wedge is upstream of the Primary Erosion Zone identified by USEPA (MPI 2007a). The sample locations will include the stations in the LPRSA and above Dundee Dam (Worksheet #18). The data collected during the Low Flow/Spring Tide Event will provide additional data in the lower reaches of the river to support the exposure point calculations for the risk assessments and FWM. This event is proposed to include combining low-flow conditions (< 400 cfs at Dundee Dam) with a spring tide in order to measure chemical transport when the highest tidal energies and tidal mixing may be occurring in the LPRSA; these data will be used to support the calibration and validation of the CFT model. Forty-four (44) samples will be collected during the Low Flow/Spring Tide Event to be analyzed for Group A and Group B target analytes as defined in Worksheet #15. Shallow (3 ft below

surface) water stations in the five locations in the LPR (RM 0 – 17.4) will be analyzed for Group C analytes (coliform bacteria) (Worksheet #15 and #18). Group D analytes (*Giardia* and cryptosporidium) will not be sampled during the Low Flow/Spring Tide Event. Frequency and type of QC samples are provided in Worksheet #20.

The water column chemical and physical data collection activities are important components of the LPRSA RI/FS and the NBSA RI/FS, which include characterizing the fate and transport of contaminants within the river, assessing risks to human health and ecological receptors, calibration and validation of the LPRSA/NBSA CFT model, and assessing the feasibility of remedial alternatives.

During the first Routine Event, a subset of twenty (20) samples will be sent to the laboratory for rapid analysis and turnaround of Group A parameters. The samples will be used to test the low-end sensitivity of the small volume analytical methods. Specifically, these samples will be collected from the following stations:

- RM10.2/13.5 at Low Slack (3 ft below surface) and Max Flood (3 ft below surface)
- RM 1.4 at Max Flood (3 ft below surface) and High Slack (3 ft below surface)
- RM 6.7/Tidal 2 at Max Ebb (3 ft below surface) and Low Slack (3 ft below surface)
- Newark Bay Northeast at High Slack (3 ft below surface) and Max Flood (3 ft below surface)
- Newark Bay South at High Slack (3 ft below surface) and Max Flood (3 ft below surface)
- Second River
- Third River
- Saddle River
- Above Dundee Dam
- Hackensack River at High Slack (3 ft below surface) and Max Ebb (3 ft below surface)
- Arthur Kill at Max Flood (3 ft below surface) and Low Slack (3 ft below surface)
- Kill van Kull at Max Flood (3 ft below surface) and Low Slack (3 ft below surface)

Upon receipt of the data from the laboratory, USEPA, CPG and Tierra will review the data to determine the efficacy of the small volume methods to achieve the Project Quality Objectives (PQOs). The CPG and Tierra will provide opinion to USEPA, who will make the final determination. No additional sampling will occur until an agreement is reached on the results of the first event Group A sample analyses and their implications for ongoing sampling and analysis methods.

Table 1 CWCM Small Volume Sampling Program

Sampling Event Type	Dundee Dam Flow (cfs)	Frequency	Location	Season/ Frequency	Analyte Groups			
					A	B	C	D
Routine Events	400 – 3,000	5[a]	LPRSA Above Dundee Dam NBSA	One in Winter Two in Spring Two in Summer	All 8 Events	One in Spring[b] Two in Summer	Two in Spring Two in Summer	Two in Summer
High Flow Events	> 3,000	2	LPRSA Above Dundee Dam NBSA	As encountered		One event[c]	Both events	Both events
Low Flow/ Spring Tide Event	< 400	1	LPRSA Above Dundee Dam	One in late Summer/early Fall		One event	One event	Not sampled

Notes:

a – At least one Routine Event will be sampled under spring tide conditions and one under neap tide conditions.

b – Group B data are being collected to support the RI, risk assessment and model validation. Data from all events are not necessary to support these efforts. Therefore, Group B data will be collected during the periods of maximum potential exposures and biological activity (i.e., summer and spring) rather than in winter.

c – Adequate Group B data will be obtained from one High Flow Event to validate the model.

Locations:

LPRSA includes:
- Saddle River
- Second River
- Third River
- LPR RM 10.2 (when flows are > 250 cfs) or LPR RM 13.5 (when flows are < 250 cfs)
- LPR RM 0
- LPR RM 1.4
- LPR RM 4.2 (when flows are > 1,000 cfs) or LPR halfway between the toe of the salt wedge and RM 1.4 up to RM 4.2 (when flows are < 1,000 cfs)
- LPR RM 6.7 (when flows are < 1,000 cfs) or LPR approximately one mile downstream of the toe of the salt wedge (when flows are < 1,000 cfs)

NBSA includes:
- Newark Bay North
- Newark Bay East
- Newark Bay Northeast
- Newark Bay Northwest
- Newark Bay South
- Kill van Kull
- Arthur Kill
- Hackensack River

Analyte Groups:

Group A - PCDD/PCDFs, PCB congeners and homologs, mercury (total and dissolved), cadmium (total and dissolved), copper (total and dissolved), lead (total and dissolved), DOC, POC, SSC, TOC, chlorophyll a, alkalinity, sulfate, total sulfide, TDS, and chloride.

Group B - TCL SVOCs, TCL VOCs, TAL metals, a subset of TAL metals in dissolved phase (arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc), titanium, methyl mercury (total and dissolved), hexavalent chromium (dissolved only), butyltins, OC pesticides, cyanide, PAHs, alkyl PAHs, hardness (calculated), TKN, ammonia and total phosphorus.

Group C - total coliform and *E. coli*, fecal coliform, fecal streptococci and fecal enterococci bacteria. Group C will only be sampled from the near surface depth at LPR stations between RM 0 and 17.4 from one tidal phase or hydrograph stage.

Group D - protozoans *Giardia* and cryptosporidium. Group D will only be sampled from the near surface depth at LPR stations between RM 0 and 17.4 from one tidal phase or hydrograph stage.

Environmental History and Setting

The LPRSA and NBSA have been highly modified to accommodate urbanization, including the development of residential areas and industrial activities. Changes in the LPR, Newark Bay (NB), and the associated watershed that accompanied European settlement and industrialization of the area to the present day are well chronicled (Iannuzzi et al. 2002). Most of the tidal marsh, mudflats, shallow nearshore areas, and tidal wetlands historically present in the LPRSA and NBSA have been either filled or dredged. Today, the majority of the shoreline in the LPR consists of riprap and sheet pile walls resulting in a highly channelized river. Upper portions of the LPR feature generally steeper and less modified shorelines with limited areas of riparian vegetation.

History of the LPR and Newark Bay

More than 200 years of industrialization and urbanization have had a substantial effect on the LPR watershed and NB, which were an important location for industry during the American Industrial Revolution (MPI 2007b). These early industries, as well as other industries that developed during the19th and early 20th centuries, used the LPR and NB for process water and waste disposal, which adversely affected water and sediment quality (Iannuzzi and Ludwig 2004). In addition, overall sediment and water quality is impaired as a result of historical direct municipal discharges, historical and continuing surface runoff, and municipal CSOs and SWOs. These impacts to general water quality were reduced in 1970 when the Clean Water Act was passed (Iannuzzi and Ludwig 2004).

In 1858, the Dundee Dam and associated locks were constructed on the LPR. After the completion of the dam, mills were built along the upper LPR near the City of Passaic (Iannuzzi et al. 2002). Above Dundee Dam, the City of Paterson was a significant center of industrialization and manufacturing beginning in the late 18th Century. In the early 20th Century, Newark, New Jersey, became one of the largest industrial cities in the United States. Industries included petroleum refineries, shipping facilities, tanneries, and various manufacturers (Battelle 2005).

Approximately 88 percent of the wetlands near the LPR and Newark Bay were lost after 1816 (Iannuzzi et al. 2002). These wetland areas were ditched, diked, drained, and covered with fill material for various purposes including: salt hay production, gardens and dairies, railroad beds, oil storage/refining, shipyards and shipping ports, mosquito control, municipal and industrial waste disposal, and airport development (Iannuzzi et al. 2002). Dredging in the LPR began in 1874 and continued until 1983, but only maintenance dredging occurred after 1940 (Iannuzzi and Ludwig 2004; MPI 2007b). The dredging allowed for commercial shipping and for deeper-draft ships to dock in the lower section of the LPR. In NB, dredging began in 1860, and between 1891 and 1934, a series of federal navigation channels and the large marine terminal at Port Newark were constructed. The dredge materials were used as fill at Port Newark and along the eastern shoreline to facilitate shoreline development. Maintenance dredging began in 1934 and continues to present day within NB and its tributaries. The latest dredging project, the New York/New Jersey Harbor Deepening Project, includes dredging in Ambrose Channel, Anchorage Channel, Kill van Kull Channel, Newark Bay Channels, the Port Jersey Channel, Arthur Kill (to Howland Hook), and Bay Ridge Channel to 50 feet deep in order to allow safe passage of new large container ships. Of these, Newark Bay Channel, Arthur Kill Channel, and Kill van Kull Channel are within the study area for the CWCM program. In addition to the Harbor Deepening Project, navigation channels throughout NB and the LPR are subject to maintenance dredging that may occur periodically, and is dependent on the rate of sediment accumulation.

The LPRSA is an operable unit of the Diamond Alkali Superfund Site. The NBSA, having been impacted by historical releases of PCDD/Fs and other contaminants due to tidal mixing, is also an operable unit of the Diamond Alkali Superfund Site. In 1984, the Diamond Alkali Superfund Site was placed on the National Priorities List as a result of past industrial operations at the Diamond Alkali plant (80-120 Lister Avenue in Newark, New Jersey), which resulted in the release of hazardous substances such as PCDDs and pesticides. Sampling of Passaic River sediments conducted during the RI/FS for the Diamond Alkali plant revealed numerous organic and inorganic compounds including, but not limited to, PCDD/PCDFs, pesticides, PCBs, PAHs, and metals. In 1994, an investigation of a 6-mile stretch of the Passaic River centered on the Diamond Alkali plant was begun. Extensive sampling showed that the sediments throughout the 6-mile study area were contaminated with organic and inorganic substances. In 2001, USEPA expanded the scope of the Superfund study to encompass the 17.4-mile stretch of the Passaic River and added a large number of PRPs for historical releases that potentially contributed to the chemicals found in the river.

Physical Setting of the LPRSA and NBSA

The LPRSA can be characterized as a stratified estuary. It receives inflows of marine (salt) water from Newark Bay and freshwater from the upper Passaic River (above Dundee Dam) and from the tributaries and the CSO/SWOs located below Dundee Dam. The less dense freshwater flows downstream over the tidally influenced salt water that, on the flood tide, moves upstream from Newark Bay. The current Conceptual Site Model (CSM) (MPI 2007b) defines the LPRSA based on three salinity regimes specified by river mile (RM):

- Freshwater River Section (RM 10–17.4) is the region usually upstream of the salt front (the salt front rarely extends further upstream than RM 13 and is upstream of RM 10 typically about 10% of the time).
- Transitional River Section (RM 6–10) is characterized by the most frequent location of the salt front with water conditions varying from slightly brackish (or oligohaline, with salinity values ranging from 0.5 parts per thousand [ppth] to 5 ppth) to moderately brackish (or mesohaline, with salinity values ranging from 5 ppth to 18 ppth).
- Brackish River Section (RM 0–6) is located downstream of the typical location of the salt front and is mesohaline, i.e., with salinity values ranging from 5 ppth to 18 ppth.

The location of the salt wedge (i.e., a wedge-shaped intrusion of salt water into the estuary that slopes downward in the upstream direction) is dependent on the phase of the tide and the volume of freshwater flowing downstream. In general, the salt wedge extends further upstream during spring flood tides and low river flow, although the leading edge of the wedge is pushed further downstream during high river flow events, and may intrude into Newark Bay during storm events with very high freshwater flows. Salinity measured near RM 10 was shown to have a maximum salinity between 3 and 6 ppth during the summer of 2005 (MPI 2007b), whereas preliminary data collected as part of the PWCM program indicate the salinity at RM 10.2 is generally less than 2 ppth under non-low flow conditions. The extent of the salt wedge is currently being characterized by data obtained during the PWCM program in conjunction with the hydrodynamic model.

The LPR is relatively shallow, with maximum thalweg (i.e., deepest point, laterally, across the river) depths ranging from a few feet (upper portions below Dundee Dam) to 30 feet near the mouth of the river. A federally authorized navigation channel exists between the mouth of the river and approximately RM 15.4 (United States Army Corps of Engineers [USACE] 2007). Surficial sediment grain size in the main stem of the LPRSA gradually transitions from coarse material (gravel or rock) typically occurring in the upstream

reach to fine material (silts and fine sand) occurring near the mouth (MPI et al. 2006, AECOM 2010a). Some deviations from this trend are found in lower areas of the LPRSA where steepened shorelines have been armored, in erosional areas associated with bridge abutments, and near river bends.

NB is approximately one mile wide and six miles long. According to USACE (1997), NB is naturally a shallow water body, with navigation channels, turning basins and docking facilities encompassing the deepest areas of the bay. The eastern side of the bay is very shallow, with depths ranging from 0.5 to 10 feet below mean low water. Areas south of Kearny Point and the Elizabeth Channel and along the western side of the bay above and below Port Newark Channel include other smaller pockets of shallow water.

The Passaic and Hackensack Rivers flow into NB from the north. NOAA (1984) estimates an annual average of 1,448 cubic feet per second (cfs) of freshwater discharges to NB from the LPR making it the largest contributor of freshwater NB; an additional 194 cfs of freshwater enters from the Hackensack River. On the south side of NB, Arthur Kill and Kill van Kull exchange saltwater with NB during tidal cycles. Suszkowski (1978) developed a sediment and water budget for NB that indicated the Kill van Kull is the largest contributor of inorganic sediments to NB; combined with Arthur Kill, the exchange provides 64% of inorganic sediments. The LPR and Hackensack River contribute approximately 31% of inorganic sediments.

PWCM Data Collection Subtask

The PWCM subtask was performed during two deployments: October – December 2009 (2009 fall deployment) and March - July 2010 (2010 spring/summer deployment). Data were collected to characterize currents and flows, temperature, salinity, and solids in the water column within the LPRSA during 2009 fall deployment, and both the LPRSA and NBSA during the 2010 spring/summer deployment. A detailed description of the field activities can be found in the PWCM QAPP and FSP Addendum (AECOM 2010a). These data have been provided to the USEPA and are currently undergoing review and analysis by the USEPA and CPG Modeling Teams.

The interaction between freshwater and estuarine tidal flows within the LPRSA impacts the fate and transport of sediment and contaminants. High freshwater flows have the potential to wash sediments into the LPR from above Dundee Dam, CSOs, SWOs and the LPRSA tributaries, resuspend the sediments, and transport sediments and constituents bound to those sediments out of the LPRSA and into the NBSA. The magnitude of tidal flows during a high freshwater flow event will impact channel velocities and transport of sediments. During low flow events on a flood tide, it may be possible for tidal action to move contaminated sediments into the LPR from Newark Bay. Flood tidal velocities that exceed ebb tidal velocities can result in net upstream transport during extended periods of low freshwater flows.

Data on the physical characteristics of the LPR have been collected by Tierra Solutions, Inc., Rutgers University for New Jersey Department of Transportation (NJDOT), and MPI for the USEPA. The primary physical and chemical water column data sets collected during the past 15 years in the LPRSA were reviewed to establish data quality and usability. Attachment 1 of the PWCM QAPP (AECOM 2010a) provides a review of these historic data sets, some examples of the data, a review of data quality, and a summary of their collective ability to address the Data Quality Objectives (DQOs) of the study. These data sets, combined with the data collected by the CPG, were used to feed the sampling design of the program defined in this QAPP.

The PWCM data were reviewed. These data, including the location of the salt water wedge under different flow regimes, and the relative and estimated suspended solids concentrations on a temporal and spatial basis, were used to develop the sampling plan. In addition to data that can be used in the risk assessments

and food web model, the number, locations, and timing of samples in the small volume CWCM program are intended to provide data to support the calibration, validation, and sensitivity testing of the CFT model. The study design of the CWCM small volume program will provide the CFT model with data from a variety of flow conditions, including extreme low or high flows.

CWCM Data Collection Subtask

Limited surface water chemical concentration data from the LPRSA have also been collected, but these data are much more limited than the existing physical data collected during the PWCM and are not sufficient to meet the needs of the LPR/Newark Bay (NB) Modeling Program. Previous chemical data have been collected by MPI and the New York and New Jersey Harbor Estuary Program (NY/NJ HEP) and are summarized in Worksheet #13 of this QAPP. Although the available data provide some understanding of the concentration of some constituents in the LPR (particularly hydrophobic organic constituents (HOCs)), they are not sufficient to adequately characterize the chemical concentrations throughout the LPRSA and under different flow regimes for use in the calibration or validation of the CFT model. Specifically, a complete set of the required data collected at multiple locations throughout the LPRSA and the NBSA over a range of flow conditions does not exist. Additional data will reduce the level of uncertainty in the LPRSA water column concentrations for use in the RAs, FWM and CFT modeling.

The chemical data collection sampling plan presented in this document has been developed to address the identified data needs and provide the data necessary to characterize chemical concentrations in the water column of the LPRSA and NBSA. The CWCM program is intended to characterize changes in chemical concentrations associated with the movement of suspended sediments over a range of tides and flow regimes.

Broadly defined, the goals of the CWCM Data Collection Program are to:

1. Collect data to support the calibration, validation, and sensitivity analysis of the CFT model. The data will provide information to develop the inputs to the model and to characterize the transport of contaminants in the LPRSA and NBSA, including the preliminary calibration of the flux of contaminants from the sediments to the water column through routine monitoring events. Water column contaminant concentration data collected in the LPRSA and NBSA with sufficient spatial coverage and frequency and over a range of flow conditions will be used to characterize potential gradients, mixing and general inputs to the system.
2. Collect data to characterize the impacts of storm-related high flow conditions on contaminant sources and transport in which resuspension of contaminants from the sediment bed and subsequent deposition from the water column are expected to dominate over other transport processes. Water column contaminant concentration data collected during high flow conditions will be used to assess the potential for increased contaminant loading to the water column from upstream sources and/or through resuspension of existing sediments.
3. Collect data to characterize the transport of contaminants under low flow conditions and maximum tidal excursion, which occurs during low flow conditions at spring tides. Water column contaminant concentration data collected during a combination of low flow and spring tide conditions will be used to better assess the up-river transport potential and support the understanding of the fate and transport for the LPRSA CSM and LPR/NB Model.
4. Estimate average water column concentrations of contaminants in the LPRSA over several seasons and flows for use in exposure point concentration estimation for the HHRA, ERA and FWM.

These monitoring goals have been designed to support the ongoing RI site characterization and modeling efforts. The goals are defined in more detail in Worksheet #11 to this document: PQOs. The PQOs include the DQOs of the project (i.e., what data are needed and how they will be collected).

The field program to achieve the goals stated above is presented in Appendix A: Field Sampling Plan Addendum, which describes the following elements:

- **Routine Events** - Water sample collection is planned at seventeen locations in the LPRSA (including the LPRSA tributaries), above Dundee Dam, Newark Bay, and Newark Bay at its confluences with the Hackensack River, Arthur Kill, and Kill van Kull for chemical analysis. A total of five hundred forty (540) samples are planned during five routine events spread over winter, spring and summer. The samples will include whole water (unfiltered) and filtered water samples, depending on the analyte. Samples will be filtered for dissolved metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc), dissolved methyl mercury, hexavalent chromium, and dissolved solids. Organic carbon will be analyzed for dissolved, total, and particulate phase. Samples for chlorophyll a will consist of the residue from a filtered aliquot of water (i.e., filtration at the laboratory). All other samples will be whole water. The sampling events will be conducted during typical medium flows (400 - 3,000 cfs at Dundee Dam) and will likely bracket several flow regimes over the tidal cycle as well as capture spring and neap tide conditions. Samples will be collected from the deepest part of the river (thalweg) and at two depths (surface and near bottom) for the stations in RM 0 – 17.4 of the LPR and NBSA, and at mid-depth for locations above Dundee Dam and the LPRSA tributaries. The proposed depths (3 feet off the bottom and 3 feet from the surface) were selected with the goal of sampling the relevant layer while avoiding artifacts associated with sampling in close proximity to the sediment bed, the pycnocline, and the water surface. The thalweg will be the targeted location as it is assumed that the denser layer with net inflow is located in the deepest part of the cross section. In addition, the highest velocities are commonly observed at the thalweg so that the rate of discharge (i.e., volume/time) is highest in that location and the collected samples will best represent the dominant flux past that cross-section.
- **High Flow Event -** Water sample collection is planned during high flow conditions (>3,000 cfs at Dundee Dam) at seventeen locations in the LPRSA (including the LPRSA tributaries), above Dundee Dam, Newark Bay, and Newark Bay at its confluences with the Hackensack River, Arthur Kill, and Kill van Kull for chemical analysis. Stations will be generally co-located with stations occupied during the Routine Events. Fourteen of the seventeen stations will be sampled four times each throughout the predicted storm hydrograph; the station above Dundee Dam will be sampled six times throughout the predicted storm hydrograph. The Arthur Kill and Kill van Kull will be sampled just before high and low slack tides. A total of two hundred twenty-eight (228) samples will be collected through two separate high flow events. The samples will include whole water (unfiltered) and filtered water samples, depending on analyte. Samples will be filtered for dissolved metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc), dissolved methyl mercury, hexavalent chromium, and dissolved solids. Organic carbon will be analyzed for dissolved, total, and particulate phase. Samples for chlorophyll a will consist of the residue from a filtered aliquot of water (i.e., filtration at the laboratory). All other samples will be whole water. Samples will be collected from two depths (surface and near bottom) at the thalweg for the stations in the LPR (RM 0- 17.4) and NBSA, and at mid-depth for locations above Dundee Dam and the LPRSA tributaries.
- **Low Flow/Spring Tide Event -** Water sample collection is planned during low flow and spring tide conditions at nine locations in the LPRSA and above Dundee Dam for laboratory analysis. Stations will be generally co-located with Routine Event stations. A total of forty-four (44) samples will be collected during the low flow/spring tide event with each station sampled four times during the tidal

cycle. The samples will include whole water (unfiltered) and filtered water samples, depending on analyte. Samples will be filtered for dissolved metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc), dissolved methyl mercury, hexavalent chromium, and dissolved solids. Organic carbon will be analyzed for dissolved, total, and particulate phase. Samples for chlorophyll a will consist of the residue from a filtered aliquot of water (i.e., filtration at the laboratory). All other samples will be whole water. Stations in the lower 17.4 miles of the LPR will be sampled at two depths; stations above Dundee Dam and in the LPRSA tributaries will be sampled from one depth.

As described above, the LPRSA encompasses 17.4 miles of the LPR from Newark Bay upstream to the Dundee Dam, and three major tributaries (Saddle River, Second River, and Third River). In addition to river flow originating above the Dundee Dam, the LPR receives flows from tributaries (e.g., Saddle River, Second River, and Third River) and numerous CSOs and SWOs that provide drainage to the adjacent urban watershed. To provide information to support the calibration and validation of the LPR/NB CFT model, Newark Bay and its major tributaries (Hackensack River, Arthur Kill and Kill van Kull) have been included in the planned Routine and High Flow Events.

QAPP Worksheet #1 (UFP-QAPP Manual Section 2.1) Title and Approval Page

Document Title: Quality Assurance Project Plan/ Field Sampling Plan Addendum. Remedial Investigation Water Column Monitoring/Small Volume Chemical Data Collection. Lower Passaic River Restoration Project.

Lead Organization: Cooperating Parties Group and de maximis, inc.

Preparer's Name and Organizational Affiliation: Kristen Durocher, AECOM

Preparer's Address, Telephone Number, and E-mail Address:

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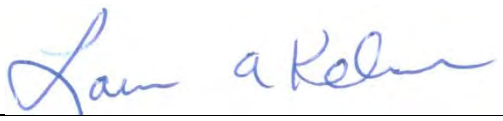
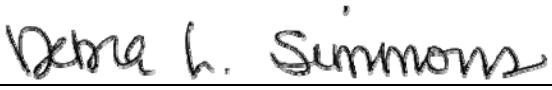
Preparation Date (Day/Month/Year): Revision 2, August 2011; Revision 3, July 2012

Investigative Organization's Project Manager



Laura Kelmar / AECOM / July 2012

Investigative Organization's Project Quality Assurance (QA) Manager



Debra Simmons / AECOM / July 2012

Lead Organization's Project Manager

Bill Potter/ Robert Law/ de maximis, inc. /
July 2012

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) QAPP Identifying Information

Site Name/Project Name:	**Diamond Alkali Operable Unit (OU 2) - LPRRP RI/FS**
Site Location:	**LPRSA and NBSA, New Jersey**
Site Number/Code:	**Comprehensive Environmental Response Compensation, and Liability Act (CERCLA) Document No. 02-2007-2009**
Operable Unit:	**OU 2 (LPRSA) and OU 3 (NBSA)**
Contractor Name:	**AECOM**
Contractor Number:	**Not Applicable (NA)**
Contract Title:	**NA**
Work Assignment Number:	**NA**

1. Identify guidance used to prepare QAPP:

   Uniform Federal Policy for Quality Assurance Project Plans. Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs. Part 1: UFP-QAPP Manual. Final Version 1. March 2005. Intergovernmental Data Quality Task Force (US Environmental Protection Agency, US Department of Defense, US Department of Energy). USEPA 505-B-04-900A.

2. Identify regulatory program: CERCLA

3. Identify approval entity: USEPA Region 2

4. Indicate whether the QAPP is a ~~generic~~ or a project-specific QAPP. (circle one)

5. List dates of scoping sessions that were held:

   November 12, 2009
   December 9, 2009
   August 11, 2010

6. List dates and titles of QAPP and FSP documents written for previous site work, if applicable:

Title
CLH 1995. *Work Plan, Vol. 1 of Passaic River Study Area Remedial Investigation Work Plans*. Chemical Land Holdings (now Tierra Solutions, Inc.), Newark, NJ. January 1995.
Tierra Solutions, Inc. 1999. *Passaic River Study Area Ecological Sampling Plan. Quality Assurance Project Plan.* March 1999.
MPI 2005. *Lower Passaic River Restoration Project. Quality Assurance Project Plan.* Prepared for US Environmental Protection Agency and US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, NY.
MPI 2006. *Lower Passaic River Restoration Project. Field Sampling Plan.* Volume 1. Prepared for US Environmental Protection Agency, US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, NY.
MPI 2007c. *QAPP/FSP Addendum for Lower Passaic River Restoration Project Empirical Mass Balance Evaluation*. December 2007.
ENSR 2008. *Lower Passaic River Restoration Project RI/FS. Quality Assurance Project Plan. RI Low Resolution Coring/Sediment Sampling*. Revision 4. ENSR, Westford, MA. October 2008.
AECOM 2008. *Lower Passaic River Restoration Project. Bathymetric Surveys. Quality Assurance Project Plan*. AECOM, Westford, MA. October 2008.

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) QAPP Identifying Information

Title
Windward 2009a. *Lower Passaic River Restoration Project. Lower Passaic River Study Area RI/FS. Quality Assurance Project Plan: Fish and Decapod Crustacean Tissue Collection for Chemical Analysis and Fish Community Survey*. Final. Prepared for Cooperating Parties Group, Newark, New Jersey. Windward Environmental LLC, Seattle, WA. August 2009.
Windward 2009b. *Lower Passaic River Restoration Project. Lower Passaic River Study Area RI/FS. Quality Assurance Project Plan: Surface Sediment Chemical Analyses and Benthic Invertebrate Toxicity and Bioaccumulation Testing*. Final. Prepared for Cooperating Parties Group, Newark, New Jersey. October 8, 2009. Windward Environmental LLC, Seattle, WA. October 2009.
AECOM 2010a. *Quality Assurance Project Plan/Field Sampling Plan Addendum. Remedial Investigation Water Column Monitoring/Physical Data Collection for the Lower Passaic River, Newark Bay and Wet Weather Monitoring. Lower Passaic River Restoration Project.* Revision 4. AECOM, Westford, MA. March 2010.
Tierra Solutions, Inc. 2011. *Combined Sewer Overflow/Stormwater Outfall Investigation Quality Assurance Project Plan. Lower Passaic River Study Area*. Revision 0. May 25, 2011.

7. List organizational partners (stakeholders) and connection with lead organization:

   This work will be performed under the requirements of the Settlement Agreement and SOW with oversight conducted by USEPA and its government partners. de maximis, inc. (acting as Project Coordinator for the CPG), AECOM, and its subcontractors, are conducting the work on behalf of the CPG and Tierra Solutions, Inc.

8. List data users: See item #7 above.

9. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table.
   Provide an explanation for their exclusion below: N/A

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to QAPP Worksheet No. or Related Documents
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	1
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	- Table of Contents - QAPP Identifying Information	2
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	3 4
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table	5 6 7 8
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)	9 9 10 and Introduction Appendix A
2.6 PQOs and Measurement Performance Criteria 2.6.1 Development of PQOs Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific PQOs - Measurement Performance Criteria Table	11 12
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table	13
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table	14 15 16

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to QAPP Worksheet No. or Related Documents
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/ Standard Operating Procedure (SOP) Requirements Table - Analytical Methods/SOP Requirements Table - Field Quality Control (QC) Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table	17 Figure 1, Appendix A 18 19 20 Appendix B 21 22
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	Appendix C 23 24 25
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation - Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow - Example Chain-of-Custody Form and Seal	26 Appendix B 27 27 Appendix B
3.4 QC Samples 3.4.1 Sampling QC Samples 3.4.2 Analytical QC Samples	- QC Samples Table	28
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records Table - Analytical Services Table - Data Management Procedures	29 30 Data Management Plan (DMP) (AECOM 2010b)

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to QAPP Worksheet No. or Related Documents
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	 - Planned Project Assessments Table - Assessment Findings and Corrective Action Responses Table	3 1 32
4.2 QA Management Reports	- QA Management Reports Table	33
4.3 Final Project Report	To be completed following data collection	NA
Data Review		
5.1 O verview 5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	- Verification (Step I) Process Table - Validation (Steps IIa and IIb) Process Table - Validation (Steps IIa and IIb) Summary Table - Usability Assessment	34 35 36 37
5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining	To be completed following data evaluation	35

QAPP Worksheet #3 (UFP-QAPP Manual Section 2.3.1) Distribution List

The following persons will receive a copy of the approved Final QAPP, subsequent QAPP revisions, addenda, and amendments:

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address	Document Control Number*
Stephanie Vaughn	Remedial Project Manager (RPM)	USEPA Region 2	212.637.3914	vaughn.stephanie@epa.gov	
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Lisa Baron	Project Manager (PM)	USACE-NY District	917.790.8306	Lisa.A.Baron@usace.army.mil	
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Tim Kubiak	Assistant Supervisor of Environmental Contaminants	United States Fish and Wildlife Service (USFWS)	609.646.9310 (ext. 26)	tim_kubiak@fws.gov	
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William Hyatt	Coordinating Counsel	Kirkpatrick and Lockhart Preston Gates Ellis LLP (K&L Gates)	973.848.4045	william.hyatt@klgates.com	
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Laura Kelmar	AECOM PM	AECOM	978.905.2266	Laura.Kelmar@aecom.com	
Philip Platcow	AECOM Regional Environmental Health and Safety (EHS) Manager	AECOM 97	8.905.2100	Philip.Platcow@aecom.com	
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QAPP Worksheet #3 (UFP-QAPP Manual Section 2.3.1) Distribution List

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address	Document Control Number*
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Bob Shoemaker Robert Kennedy	Project Chemist Alternate Project Chemist	AECOM	978.905.2393 978.905.2269	Robert.Shoemaker@aecom.com Robert.Kennedy@aecom.com	
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Rafael Canizares	Modeling Team Task Leader and Liaison	Moffatt & Nichol	212.768.7454	rcanizares@moffattnichol.com	
Mike Johns	ERA Task Leader	Windward Environmental	206.378.1364	MikeJ@windwardenv.com	
Ken Cadmus	Vessel Subcontractor Lead	Ocean Survey, Inc. (OSI)	860.388.4631	kac@oceansurveys.com	
Other project team members and stakeholders					

*Uncontrolled electronic copies will be available on www.ourpassaic.org

QAPP Worksheet #4 (UFP-QAPP Manual Section 2.3.2) Project Personnel Sign-Off Sheet

Organization: A completed sign-off sheet will be maintained in the files for each organization represented below.

Project Personnel	Title	Telephone Number	Signature*	Date QAPP Read
Bill Potter/Robert Law	CPG Project Coordinator	908.735.9315		
Polly Newbold	CPG QA Coordinator	908.479.1975		
Laura Kelmar	AECOM PM	978.905.2266		
Kristen Durocher	AECOM CWCM Task Manager	603.581.6608		
Don Kretchmer	AECOM FTM/SSO	603.387.0532		
Debra Simmons	AECOM Project QA Manager	978.905.2399		
Bob Shoemaker	AECOM Project Chemist	978.905.2393		
Robert Kennedy	AECOM Project Chemist (alternate)	978.905.2269		
James Herberich	AECOM Data Management Task Manager	978.905.2243		
Lisa Krowitz	AECOM Data Validation Coordinator	978.905.2278		
Ken Cadmus	OSI Vessel Subcontractor Lead	860.388.4631		
See Worksheet #30	Laboratory PM	See Worksheet #30		

*Signature indicates that personnel have read the applicable QAPP sections and will perform the tasks as described.

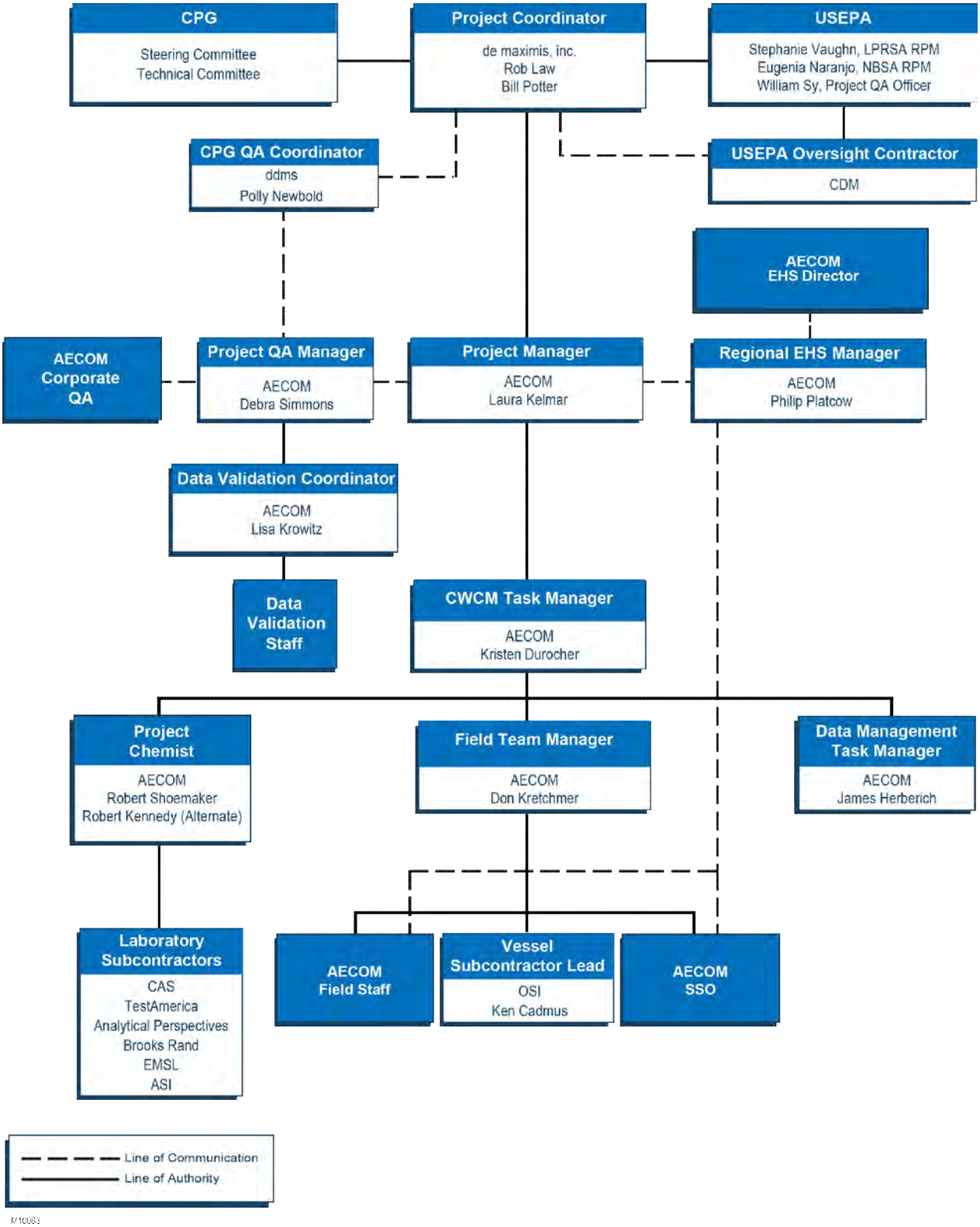
QAPP Worksheet #4 (UFP-QAPP Manual Section 2.3.2) Project Personnel Sign-Off Sheet

Organization:

Project Personnel	Title	Telephone Number	Signature*	Date QAPP Read

*Signature indicates that personnel have read the applicable QAPP sections and will perform the tasks as described.

QAPP Worksheet #5 (UFP-QAPP Manual Section 2.4.1) Project Organizational Chart



QAPP Worksheet #6 (UFP-QAPP Manual Section 2.4.2) Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Field activities status and issues	AECOM FTM	Don Kretchmer	603.387.0532	Communicate daily, or as needed, with AECOM field personnel, subcontractors, and AECOM CWCM Task Manager directly, or via e-mail or phone. Minor work plan deviations and/or proposed revisions will be documented and communicated in writing, with a copy sent to USEPA.
	CPG Project Coordinator	Bill Potter/ Robert Law (de maximis, inc.)	908.735.9315	Communicate daily with USEPA RPM via e-mail or phone.
Sampling schedule including implementation of flow-dependent sampling	CPG Project Coordinator	Bill Potter/ Robert Law (de maximis, inc.)	908.735.9315	The USEPA will be notified as soon as the CPG and its contractors confirm that conditions appear to be favorable for a high flow or low flow sampling event.
Sampling progress/laboratory coordination	AECOM CWCM Task Manager	Kristen Durocher	603.581.6608	Communicate daily, or as needed, with AECOM FTM and Project Chemist via e-mail or phone.
Health and safety briefings and updates	AECOM SSO	Don Kretchmer	603.387.0532	Communicate daily, or as needed, with field personnel and boat operators directly, or via e-mail or phone.
Significant health and safety concerns or incidents	AECOM SSO	Don Kretchmer	603.387.0532	Communicate immediately with AECOM Regional EHS Manager, CWCM Task Manager, and AECOM PM.

QAPP Worksheet #6 (UFP-QAPP Manual Section 2.4.2) Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Sampling vessel operations	Sampling Vessel Captain	To be determined OSI	860.388.4631	Communicate daily, or as needed, with AECOM FTM directly. The sampling vessel captain has the ultimate authority for stopping work while working on water. The vessel captain, in consultation with the SSO, will follow guidelines documented in the site-specific Health and Safety Plan (HASP). In addition, standard safe boating practices related to weather conditions and vessel operations will apply, even if not specifically addressed in the HASP.
Analytical laboratory issues, including coordination with field, schedule, and technical issues	AECOM Project Chemist	Bob Shoemaker Robert Kennedy (alternate)	978.905.2393 978.905.2269	Communicate with AECOM FTM and Laboratory PM as needed via phone or e-mail.
Analytical data validation issues	AECOM Data Validation Coordinator	Lisa Krowitz	978.905.2278	Communicate with Laboratory PM as needed via phone or email.
Audit findings (field and/or laboratory)	AECOM Project QA Manager	Debra Simmons	978.905.2399	Communicate findings to AECOM CWCM Task Manager or Laboratory PM (as appropriate); transmit final audit reports, including corrective actions (CA), to AECOM PM, AECOM CWCM Task Manager, CPG Project Coordinator, and CPG QA Coordinator.
	CPG Project Coordinator	Bill Potter/ Robert Law (de maximis, inc.)	908.735.9315	CPG Project Coordinator will provide final audit reports to USEPA RPM.
Issues potentially affecting PQOs	AECOM FTM	Don Kretchmer	603.387.0532	Communicate as needed with AECOM QA Manager and AECOM CWCM Task Manager via
	OSI Vessel Subcontractor Lead	Ken Cadmus	860.388.4631	

QAPP Worksheet #6 (UFP-QAPP Manual Section 2.4.2) Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
	AECOM Project Chemist	Bob Shoemaker Robert Kennedy (alternate)	978.905.2393 978.905.2269	e-mail or phone. Notification of the CPG QA Coordinator as appropriate.
	AECOM Data Validation Coordinator	Lisa Krowitz	978.905.2278	
	CPG Project Coordinator	Bill Potter/ Robert Law (de maximis, inc.)	908.735.9315	CPG Project Coordinator will communicate to USEPA RPM.
	AECOM CWCM Task Manager	Kristen Durocher	603.581.6608	Communicate with AECOM QA Manager and AECOM PM as needed, via e-mail or phone. Notification of the CPG QA Coordinator as appropriate. Significant work plan modifications will be reported to USEPA in writing prior to implementation.
Water sample collection task implementation, including sampling, analysis, and reporting	AECOM FTM	Don Kretchmer	603.387.0532	Communicate with AECOM CWCM Task Manager as needed, via e-mail or phone.
	CPG Project Coordinator	Bill Potter/ Robert Law (de maximis, inc.)	908.735.9315	Communicate daily with USEPA RPM via e-mail or phone.
Project status and issues (internal)	AECOM PM	Laura Kelmar	978.905.2266	Communicate with CPG Project Coordinator daily, or as needed, via email or phone, and submit monthly progress reports.
Project status and issues (external)	CPG Project Coordinator	Bill Potter/ Robert Law (de maximis, inc.)	908.735.9315	Communicate with USEPA RPM as needed via e-mail or phone.

QAPP Worksheet #6 (UFP-QAPP Manual Section 2.4.2) Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
	CPG Coordinating Counsel	William Hyatt / Dawn Monsen (K&L Gates)	973.848.4045 or 4148	In the event the CPG Project Coordinator is unavailable for communication with USEPA, the AECOM PM will notify the Coordinating Counsel prior to contacting USEPA.
Quality status and issues	CPG QA Coordinator	Polly Newbold	908.479.1975	Communicate with CPG Project Coordinator as needed via email or telephone
Data management	AECOM FTM	Don Kretchmer	603.387.0532	Communicate with the Data Management Task Manager via email; transmit final field locations and sample collection information daily.
	AECOM Data Management Task Leader	Jim Herberich	978.905.2243	Maintain comprehensive project technical database, communicate with AECOM FTM to receive data from the field; communicate with Laboratory PM(s) to receive analytical result data, communicate with AECOM Data Validation Coordinator to facilitate validation review and database update; communicate with AECOM CWCM Task Manager to provide data for review; and provide data deliverables to USEPA.
	Laboratory PM	See Worksheet #30	See Worksheet #30	Transmit Electronic Data Deliverables (EDDs) to Data Management Task Manager
	AECOM Data Validation Coordinator	Lisa Krowitz	978.905.2278	Communicate with Data Management Task Manager regarding final data qualifiers.

QAPP Worksheet #6 (UFP-QAPP Manual Section 2.4.2) Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Stop Work (technical non-compliance)	AECOM Field team, Project QA Manager, Project Chemists, and Data Management Task Manager			Any personnel believing that a work stoppage is necessary shall first verbally notify the CWCM Task Manager or the AECOM PM, who will in turn verbally notify de maximis, inc. and/or AECOM Project QA Manager, if necessary. Given the potential significance of such communications, this will occur as quickly as possible.
	CPG Project Coordinator	Bill Potter/ Robert Law (de maximis, inc.)	908.735.9315	Communicate any stop work order to USEPA RPM via e-mail or phone.

QAPP Worksheet #7 (UFP-QAPP Manual Section 2.4.3) Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications[1]
Robert Law	CPG Project Coordinator	de maximis, inc.	Overall responsibility for the safe and proper execution of task. Be available to discuss and review technical and other issues that may arise during work. Periodically review and audit work to ensure that work plan, project quality assurance/quality control (QA/QC), and Health and Safety including both boating and hazardous materials worker safety procedures are being followed. All deviations from approved project plans will be discussed with and approved by the CPG Project Coordinator. Primary point of contact with the USEPA, its oversight contractor and the LPRSA Partner Agencies.	PhD, Geology, 26 years experience
Willard Potter	CPG Project Coordinator	de maximis, inc.	Overall responsibility for the safe and proper execution of task. Be available to discuss and review technical and other issues that may arise during work. Periodically review and audit work to ensure that work plan, project QA/QC, and Health and Safety including both boating and hazardous materials worker safety procedures are being followed. All deviations from approved project plans will be discussed with and approved by the CPG Project Coordinator. Primary point of contact with the USEPA, its oversight contractor and the LPRSA Partner Agencies.	BS, Chemical Engineering, 36 years experience
Laura Kelmar	AECOM PM	AECOM	Overall responsibility for completion of RI tasks in accordance with SOW requirements including technical, financial, and scheduling. Primary point of contact with CPG Project Coordinator.	BS, Chemical Engineering, MS, Environmental Engineering, 20 years experience

QAPP Worksheet #7 (UFP-QAPP Manual Section 2.4.3) Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications[1]
Kristen Durocher	CWCM Task Manager	AECOM	Responsible for the execution and completion of the CWCM program, including procurement of subcontractors, review of task deliverables, and serving as the focus for coordination of all field and laboratory tasks. The CWCM Task Manager will keep the AECOM PM apprised of the status of the task, as well communicate any issues with the schedule, budget, or achievement of the task objectives.	BA Environmental Studies and Northern Studies, 18 years experience
Don Kretchmer (or designee)	FTM	AECOM	Responsible for implementing field sampling activities in accordance with the approved plans (FSP, QAPP, and HASP). Primary responsibilities include directing activities on site, monitoring subcontractor performance in the field, reviewing field records, and communicating daily with the AECOM CWCM Task Manager regarding status, quality, issues, or delays.	BS Natural Resources, MS Water Resource Management, 26 years experience
Debra Simmons	Project QA Manager	AECOM	Responsible for reviewing and approving QA procedures, ensuring that planned QA assessments (e.g., technical surveillance audits [TSA], data validation) are conducted according to the QAPP/FSP Addendum and the AECOM Quality Management Plan (QMP), (AECOM 2009) and reporting on the adequacy of the QA Program to the AECOM PM.	BS, Biology, 28 years experience
Philip Platcow	Regional EHS Manager	AECOM	Responsible for ensuring that the objectives of AECOM's Health and Safety Program are met and for monitoring task activities for conformance to the HASP.	MS, Industrial Hygiene, 25 years experience

QAPP Worksheet #7 (UFP-QAPP Manual Section 2.4.3) Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications[1]
Don Kretchmer (or designee)	SSO	AECOM	Responsible for monitoring subcontractor/field team performance in the field and communicating daily with the AECOM FTM, CWCM Task Manager or Regional EHS Manager, as appropriate, regarding health and safety, etc. Will ensure that the objectives of the project's Health and Safety Program are met.	BS Natural Resources, MS Water Resource Management, 26 years experience
Bob Shoemaker	Project Chemist	AECOM	Responsible for laboratory procurement and monitoring of progress and will be the primary point of contact with the laboratory(ies). The Project Chemist will also be responsible for communicating any issues that could affect achievement of the PQOs to the AECOM CWCM Task Manager and the AECOM Project QA Manager.	BA, Biology and Environmental Science, 13 years experience
Robert Kennedy	Project Chemist - alternate	AECOM	As needed, serve as alternate to the Project Chemist, performing duties described above.	BA, Chemistry, 27 years experience
Lisa Krowitz	Data Validation Coordinator	AECOM	Responsible for managing the validation task, including ensuring that validation is conducted and documented according to the requirements of this QAPP, and interacting with the laboratories to resolve any issues.	MS, Environmental Science, 24 years experience
James Herberich	Data Management Task Manager	AECOM	Responsible for data management for project, Including overall responsibility for database quality and structure, including graphical representation of data.	BA, Engineering Sciences, 22 years experience
Polly Newbold	CPG QA Coordinator	ddms, inc.	Provides oversight of project QA/QC. Periodically review and audit operations to ensure that QAPP/FSP Addendum QA/QC procedures are being followed.	BS, Textile Science, 26 years experience

QAPP Worksheet #7 (UFP-QAPP Manual Section 2.4.3) Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications[1]
Ken Cadmus	Vessel Subcontractor Lead	OSI	Responsible for vessel operation, providing crew and equipment. Acts as the primary point of contact between AECOM FTM and CWCM Task Manager and vessel crew.	MS, Civil Engineering, 16 years experience
John Reynolds	Laboratory PM	TestAmerica	Acts as the primary point of contact at TestAmerica facilities for the AECOM Project Chemist to communicate and resolve sampling, receipt, analysis, and storage issues. Coordinates communication for all TestAmerica network laboratories.	BS, Biology, 16 years experience
Ed Wallace	Laboratory PM	Columbia Analytical Services (CAS)	Acts as the primary point of contact at CAS facilities for the AECOM Project Chemist to communicate and resolve sampling, receipt, analysis, and storage issues. Coordinates communication for all CAS network laboratories	MS, Chemistry, 34 years experience
Misty Kennard-Mayer	Laboratory PM	Brooks Rand, LLC	Acts as the primary point of contact at Brooks Rand, LLC for the AECOM Project Chemist to communicate and resolve sampling, receipt, analysis, and storage issues.	BS, Environmental Science, 7 years experience
Todd Vilen	Laboratory PM	Analytical Perspectives	Acts as the primary point of contact at Analytical Perspectives for the AECOM Project Chemist to communicate and resolve sampling, receipt, analysis, and storage issues.	BA, Chemistry; BS, Aquatic Biology, 24 years experience
Jason Dobranic	Laboratory PM	Environmental Molecular Sciences Laboratory (EMSL), Inc.	Acts as the primary point of contact at EMSL for the AECOM Project Chemist to communicate and resolve sampling, receipt, analysis, and storage issues.	PhD, Microbiology, 9 years experience
Paul Warden	Laboratory PM	Analytical Services, Inc. (ASI)	Acts as the primary point of contact at ASI for the AECOM Project Chemist to communicate and resolve sampling, receipt, analysis, and storage issues.	BS, Biology, 20+ years experience

[1] Resumes of all individuals are available upon request.

QAPP Worksheet #8 (UFP-QAPP Manual Section 2.4.4) Special Personnel Training Requirements Table

Project Function	Specialized Training by Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
FTM/SSO	40 hour Hazardous Waste Operations and Emergency Response (HAZWOPER)	Compliance Solutions	July 2011	Don Kretchmer	FTM/SSO/AECOM	AECOM
Field Personnel	40 hour HAZWOPER	AECOM	Various	Various	Various/AECOM	AECOM
	HAZWOPER 8-hr Refresher	AECOM	within 12 mo			
	Hazmat awareness	AECOM	Various			
Sampling Vessel Captain	40 hour HAZWOPER	Varies	Various	Various Captains	OSI	OSI
	HAZWOPER 8-hr Refresher	Varies	within 12 mo			
	U.S. Coast Guard license	U.S. Coast Guard	Various			
	First Aid/CPR	Varies	within 24 mo			

QAPP Worksheet #9 (UFP-QAPP Manual Section 2.5.1) Project Scoping Session Participants Sheet

Project Name: RI Water Column Monitoring/Small Volume Chemical Data Collection **Projected Date(s) of Sampling: October 2010** **Project Manager: Bill Potter/ Robert Law**	**Site Name: Diamond Alkali OU 2 - LPRRP RI/FS** **Site Location: LPRSA**
Date of Session: November 12, 2009 **Scoping Session Purpose: Discussion among de maximis, inc./ AECOM/Windward/Moffatt & Nichol for 2010 CWCM program.**	

Name	Affiliation	Phone #	E-mail Address	Project Role
Bill Potter	de maximis, inc.	908.735.9315	otto@demaximis.com	CPG Project Coordinator
Robert Law	de maximis, inc.	908.735.9315	rlaw@demaximis.com	CPG Project Coordinator
Bill Lee	de maximis, inc.	908.735.9315	wjlee@demaximis.com	CPG Project Coordinator
Kristen Durocher	AECOM	603.528.8916	kristen.durocher.@aecom.com C	WCM Task Manager
Mike Sanborn	AECOM	250.475.6355	Mike.sanborn@aecom.com	AECOM planning team
Doug Bright	AECOM	250.475.6355	Doug.bright@aecom.com	AECOM planning team
Robert Kennedy	AECOM	978.589.3343	Robert.kennedy@aecom.com	AECOM planning team
Tim Iannuzzi	ARCADIS for Tierra Solutions, Inc.	410.295.1205	tim.ianuzzi@arcadis-us.com	Technical Committee (TC) member
Alain Hebert	ARCADIS for Tierra Solutions, Inc.	609.860.0597	ahebert@bbl-inc.com T	C member
Diane Waldschmidt	EDS for Tierra Solutions,, Inc.	412.486.6989	edatas@aol.com T	C member
Cliff Firstenberg	Tierra Solutions, Inc.	757.258.7720	cefirstenberg@cox.net T	C member
Kavin Ghandi	ARCADIS for Tierra Solutions, Inc.	609.860.0597	Kavin.Gandhi@arcadis-us.com T	C member
Paul Brzozowski	Tierra Solutions, Inc.	732.426.5851	Paul.brzozowski@tierra-inc.com T	C member
Betsy Ruffle	AECOM	978.589.3071	Betsy.ruffle@aecom.com HH	RA team
Lisa Saban	Windward Environmental	206.378.1364	lisas@winwardenv.com	ERA team FWM team
Rafael Canizares	Moffatt & Nichol	212.768.7454	rcanizares@moffattnichol.com	CFT modeling team
Rooni Mathew	Moffatt & Nichol	212.768.7454	rmathew@moffattnichol.com	CFT modeling team

Comments/Decisions:

Representatives of the LPR Project Team met to discuss options for collecting chemical water column data. High volume techniques were discussed, and the group determined that DQOs and data use objectives (DUOs) were not well defined for the CWCM program. As a result of this meeting, it was agreed that a scoping meeting with TC members should be convened once DQOs and DUOs were well defined. This meeting was scheduled for December 9, 2009 in Newark, New Jersey.

QAPP Worksheet #9 (UFP-QAPP Manual Section 2.5.1) Project Scoping Session Participants Sheet

Project Name: RI Water Column Monitoring/Small Volume Chemical Data Collection **Projected Date(s) of Sampling: October 2010** **Project Manager: Bill Potter/ Robert Law**	**Site Name : Diamond Alkali OU 2 - LPRRP RI/FS** **Site Location : LPRSA**

Date of Session: December 9, 2009

Scoping Session Purpose: Discussion among de maximis, inc./ AECOM/Windward/Moffatt & Nichol for DQO/DUOs 2010 CWCM program.

Name	Affiliation	Phone #	E-mail Address	Project Role
Robert Law	de maximis	908.735.9315	rlaw@demaximis.com	CPG Project Coordinator
Bill Lee	de maximis	908.735.9315	wjlee@demaximis.com	CPG Project Coordinator
Kristen Durocher	AECOM	603.528.8916	kristen.durocher.@aecom.com C	WCM Task Manager
Doug Bright	AECOM	250.475.6355	Doug.bright@aecom.com	AECOM planning team
Robert Kennedy	AECOM	978.589.3343	Robert.kennedy@aecom.com	AECOM planning team
Tim Iannuzzi	ARCADIS for Tierra Solutions, Inc.	410.295.1205	tim.ianuzzi@arcadis-us.com T	C member
Diane Waldschmidt	EDS for Tierra Solutions, Inc.	412.486.6989	edatas@aol.com T	C member
Cliff Firstenberg	Tierra Solutions, Inc.	757.258.7720	cefirstenberg@cox.net T	C member
Paul Brzozowski	Tierra Solutions, Inc.	732.426.5851	Paul.brzozowski@tierra-inc.com T	C member
Suzanne Replinger	Windward Environmental 206.378	.136 4	suzanner@windwardenv.com ERA	team
Karen Tobiason	Windward Environmental 206.378	.136 4	karent@winwardenv.com ERA	team
Rafael Canizares	Moffatt & Nichol	212.768.7454	rcanizares@moffattnichol.com	CFT modeling team
Rooni Mathew	Moffatt & Nichol	212.768.7454	rmathew@moffattnichol.com	CFT modeling team
Leo Postma	Deltares	31.(0)15.285.8	Leo.postma@deltares.nl	CFT modeling team
Richard Wroblewski	Givaudan Fragrances Corp.	973.448.6339	Richard.Wroblewski@givaudan.com T	C member

Comments/Decisions:

The above parties discussed the development of the CWCM program, with the DUOs and DQOs defined by the end users (RA and modeling teams). It was determined that the best approach to the CWCM program was to provide a phased approach, including both small volume and high volume sampling. This is consistent with FSP1 (MPI 2006).

QAPP Worksheet #9 (UFP-QAPP Manual Section 2.5.1) Project Scoping Session Participants Sheet

Project Name: RI Water Column Monitoring/Small Volume Chemical Data Collection **Projected Date(s) of Sampling: October 2010** **Project Manager: Bill Potter/ Robert Law**	**Site Name: Diamond Alkali OU 2 - LPRRP RI/FS** **Site Location: LPRSA**

Date of Session: August 11, 2010

Scoping Session Purpose: Discussion among de maximis, inc./ AECOM/ Moffatt & Nichol/USEPA for 2010 small volume CWCM program.

Name	Affiliation	Phone #	E-mail Address	Project Role
Bill Potter	de maximis, inc.	908.735.9315	otto@demaximis.com	CPG Project Coordinator
Robert Law	de maximis, inc.	908.735.9315	rlaw@demaximis.com	CPG Project Coordinator
Kristen Durocher	AECOM	603.528.8916	kristen.durocher.@aecom.com C	WCM Task Manager
Alice Yeh	USEPA	212.637.4427	Yeh.alice@epa.gov USEP	A RPM
AmyMarie Accardi-Dey	Louis Berger, Inc.	914.798.3712	aacardidey@loiusberger.com	NBSA oversight for USEPA
William Sy	USEPA 732.632.476	6	Sy.william@epa.gov Proj	ect
Ed Garland	HydroQual, Inc.	201.529.5151	Egardland@hydrolqual.com	USEPA consultant
Ed Garvey	Louis Berger, Inc.	914.798.3712	egarvey@louisberger.com	NBSA oversight for USEPA
Elizabeth Barrows	Battelle	631.941.3213	barrowse@battelle.org	USEPA consultant
Eugenia Naranjo	USEPA	212.637.3558	Naranjo.eugenia@epa.gov NBSA	RPM
Jim Fitzpatrick	HydroQual, Inc.	201.529.5151	jfitzpatrick@hydroqual.com	USEPA consultant
Liz Butler	USEPA	212.637.4396	Butler.elizabeth@epa.gov U	SEPA
Marian Olsen	USEPA	212.637.4313	Olsen.marian@epa.gov	USEPA HHRA
Pravi Shrestha	Exponent	949.242.6037	pshretha@exponent.com	Tierra Solutions, Inc. consultant
Ricardo Petroni	Anchor-QEA	201.930.9890	rpetroni@anchorqea.com	TC consultant
Sharon Budney	CDM	732.590.4662	budneysl@cdm.com	USEPA consultant
Stephanie Vaughn	USEPA	212.637.3914	Vaughn.stephanie@epa.gov	LPRSA RPM
Tom Gallagher	HydroQual, Inc.	201.529.5151	tgallagher@hydrolqual.com	USEPA consultant
Rafael Canizares	Moffatt & Nichol	212.768.7454	rcanizares@moffattnichol.com	CFT modeling team
Rooni Mathew	Moffatt & Nichol	212.768.7454	rmathew@moffattnichol.com	CFT modeling team

Comments/Decisions:

Representatives of the CPG LPR Project Team met with USEPA and its contractors to discuss the overall scope of the CWCM program, and the general terms of the small volume QAPP.

The overall design of the small volume CWCM program was presented to USEPA and its contractors. The program outline was framed within the context of the larger CWCM program, which will include high volume sampling which will be provided in a separate QAPP/FSP Addendum.

The program is complex and several questions were asked for clarification purposes by USEPA and its contractors:

QAPP Worksheet #9 (UFP-QAPP Manual Section 2.5.1) Project Scoping Session Participants Sheet

1) What are the criteria for the Low Flow sampling event? Flow at what gauge needs to be maintained for how long?

Response: The river gage at Dundee Dam will be the point for which all events will be measured. When flow in the river at Dundee Dam reaches and maintains no more than 500 cubic feet per second (cfs), a Low Flow sampling event may occur.

2) Will the small volume QAPP include information about the high volume program, including number of samples, number of stations, number of events, and analyte list?

Response: The high volume program is still being developed. The CPG and its contractors would like to meet with USEPA and their contractors to discuss the high volume program. The small volume QAPP will allude to the high volume program, and the overall draft data use objectives for the high volume program.

3) There were sampling constraints associated with the PWCM program due to short hold times associated with some of the analytes. Will the CWCM have the same constraints? (CDM)

Response: Yes, the priority analyte list for the CWCM small volume program includes the same physical parameters sampled during the PWCM program, some of which have 48 hr holding times. (may have been Sharon Budney, CDM)

4) What are the procedures that will trigger a sampling event, particularly the storm events? How will this be relayed to the USEPA and its contractors? (CDM)

Response: Similar to the communication protocol in place for the PWCM program, the USEPA will be notified as soon as the CPG and its contractors confirm that conditions appear to be favorable for a storm sampling event. The specific communication protocol will be provided in Worksheet #6 of the small volume QAPP.

5) Why aren't PAHs included in the priority analyte suite? (Ed Garvey, LBI)

Response: The priority analyte suite was selected based on the parameters identified in the Modeling Work Plan (MWP) for model calibration. The MWP specifically identifies PCDD/PCDF and PCB congeners for model calibration. The CPG has included mercury to that list. The proposed priority analyte suite is adequate to meet the DUO for model calibration in the MWP.

6) Why aren't OC pesticides included in the analyte suite? And should PAHs be analyzed using high resolution methods? (AmyMarie Accardi-Dey, LBI)

Response: OC pesticides are part of the full analyte suite, and were left off the slide unintentionally. They will be analyzed using high resolution methods. PAHs will be analyzed by Selective Ion Monitoring (SIM) techniques.

QAPP Worksheet #9 (UFP-QAPP Manual Section 2.5.1) Project Scoping Session Participants Sheet

7) If the priority analyte suite chemicals are not detected using these small volumes, will the CPG continue to collect these data? (AmyMarie Accadi-Dey, LBI)

   Response: Yes. The model can use non-detects, and the data can be used to provide some information regarding concentrations of these analytes.

8) Please explain the criteria for reducing the sampling from four times per tidal cycle to two times per tidal cycle.(AmyMarie Accardi-Dey LBI)

   Response: Following two rounds of Routine Event sampling (when samples are collected four times per tidal cycle at each location), the data will be reviewed. If there are few differences in the concentrations of priority constituents, USEPA will be consulted to determine if reducing the sampling to twice per tide cycle would still allow the program to meet DUOs while substantially reducing analytical costs.

9) A comment was made that analysis of the contaminant concentration in the solids fraction of the boundary conditions (i.e., tributaries), rather than the whole water sample, would be the most useful data for estimation of inputs from the LPRSA tributary boundaries. (Ed Garvey, LBI)

10) Based on a question by AmyMarie Accardi-Dey (LBI), clarification was provided that the small volume program would utilize “standard” water volumes, such as 1 to 2 liters for SVOCs, and that the high volume program would utilize large volumes (as needed) to lower the detection limits to meet RA data quality levels.

11) Based on a question from Ed Garvey (LBI), clarification was provided that the small volume program would provide whole water data, with the exception of some metals for which aquatic life water quality criteria were based on the dissolved fraction, and hexavalent chromium, which would be dissolved phase only. The high volume program would provide dissolved water column organic concentrations, and the associated concentrations on the solid fraction. The high volume program would provide any site-specific partitioning coefficients to the model. The model does not integrate variability of partitioning coefficients.

12) Clarification to the number of samples collected at each location was provided as concerns were expressed by Ed Garvey (LBI) that only one sample data point would be available per station.

13) A general description of the high volume program was provided indicating that the CPG is considering an Infiltrex-type system will be used to sample and at least two sampling events would occur. The numbers of locations, analyte list and specific methods have yet to be determined.

As a result of this meeting, it was agreed that a scoping meeting with USEPA and their contractors should be convened to discuss the high volume program. This meeting was not scheduled. Further, it was acknowledged that the small volume QAPP would be provided to USEPA by Labor Day 2010.

QAPP Worksheet #10 (UFP-QAPP Manual Section 2.5.2) Problem Definition

The problem to be addressed by the project:

The proposed sampling program consists of the collection of water column samples to support the characterization of the nature and extent of contaminants in the water column in order to understand the characteristics of the water column in the main stem of the LPR (extending from RM 0 to RM 17.4), the major LPRSA tributaries (Saddle River, Second River, Third River), above Dundee Dam, and within Newark Bay and its confluences with the Hackensack River, Arthur Kill, and Kill van Kull. Chemical water column sampling supports the understanding of the nature and extent of contaminants, and provides data to conduct the RAs and FWM model, and LPR/NB CFT model. CWCM is a required element of LPRRP FSP1 for completion of the LPRSA RI/FS per the May 2007 Settlement Agreement and SOW (USEPA 2007a).

The field and laboratory data collected during this program will be utilized in completion of the RI/ FS to:

- Understand the relationship between tidal stage, freshwater flow and salinity patterns, and chemical concentrations in the water column. This investigation has been designed to evaluate a range of hydrologic conditions (e.g., high and low watershed runoff) in order to understand the influence of these conditions on water column contaminant concentrations;
- Aid in the characterization of potential internal and external sources of contaminants;
- Characterize the variation in chemical concentrations within the water column under different hydrologic events and in space; and
- Provide information on the temporal and spatial concentrations of contaminants in the water column for use in the RAs and modeling programs that are currently a part of the LPRSA and NB RIs.

The introduction to the QAPP provides background site information. The PQOs provided in Worksheet #11 include more detail for each sampling objective.

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Who will use the data?

CPG, Tierra Solutions, Inc. and USEPA will use these data for CERCLA-related assessments, including the LPRSA RAs and FWM, the LPR/NB CFT Model and other tasks associated with both the LPRSA RI/FS and the NBSA RI/FS.

What will the data be used for?

The following presents the DUOs for the CWCM small volume chemical data collection program:

- The data will be used as part of the overall RI/FS to characterize the nature and extent of contaminants in surface water.
- Consistent with the *LPRSA Human Health and Ecological Risk Assessment Streamlined 2009 Problem Formulation Document* (PFD) (Windward and AECOM 2009), the data will be used to assess potential exposure dose and risk from direct contact (i.e., incidental ingestion, dermal contact, inhalation of volatiles) with chemicals of potential concern (COPCs) in surface water by human receptors;
- Consistent with the PFD (Windward and AECOM 2009), the data will be used to assess potential exposure dose or concentration and potential risk from ingestion and/or direct contact with chemicals of potential ecological concern (COPECs) in surface water by:
  - aquatic plants (direct contact only),
  - zooplankton,
  - benthic invertebrate community,
  - macroinvertebrates,
  - mollusks,
  - benthic fish,
  - pelagic fish,
  - amphibians/reptiles (direct contact only),
  - herbivorous and omnivorous birds (ingestion only),
  - sediment-probing shorebirds (ingestion only),
  - piscivorous birds (ingestion only), and
  - piscivorous mammals (ingestion only).

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- Concentrations of COPCs in surface water will also be compared to applicable, relevant or appropriate requirements (ARARs) (e.g., state or federal water quality standards).
- The data will be used to estimate contribution of COPCs in surface water to the bioaccumulation of COPCs in the food chain.
- The data will be used to support the CFT model specifically for:
  - Characterization of the initial conditions;
  - Calibration, validation and sensitivity testing of the CFT model under various flow conditions; and,
  - Development of contaminant loadings to the model.

What types of data are needed (matrix, target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)?

Worksheet #15 provides a full list of constituents. The analyte list as outlined in the Fish/Decapod QAPP and Benthic QAPP (Windward 2009a 2009b) was used as the basis for the development of the proposed chemistry analyte list for the small volume CWCM program. This list includes the target analytes for the HHRA, ERA and FWM including PAHs, alkyl PAHS, butyltins, TAL metals, titanium, hexavalent chromium, mercury and methyl mercury, PCB congeners and homologs, PCDD/PCDFs, OC pesticides, TCL SVOCs (plus TICs), and TCL VOCs (plus TICs). Additional physical parameters such as major anions, nitrogen, alkalinity, hardness (as a calculated value), solids fractions, chlorophyll a, phosphorous, and organic carbon fractions will also be collected to support the FWM and CFT model. All samples submitted for analysis will be analyzed as whole water except as noted above.

As the initial phase of the CWCM data collection, this investigation will include a number of analyses. All proposed analyses have been assigned to one of four groups described in the following paragraphs:

Group A - A list of target physical, and inorganic and organic chemical analyses is proposed for the full set of stations and depths (refer to Worksheet #15). These analytes will be measured in all samples during each of the eight events and will be used primarily for estimation of EPCs for the HHRA, ERA and FWM, and in the CFT model calibration. This analyte list is consistent with the Modeling Work Plan (HydroQual, 2006) and includes PCDD/PCDFs, PCB congeners and homologs, mercury (total and dissolved), and supporting parameters to be used in the CFT model (i.e., DOC, POC, SSC, TOC, chlorophyll a, alkalinity, sulfate, total sulfide, TDS, and chloride). Total and dissolved cadmium, copper and lead are also included in the Group A list.

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Group B - A list of physical, and inorganic and organic chemical analyses is proposed for the full set of stations and depths for a subset of sampling events (refer to Worksheet #15). These parameters will be used to support EPC calculations for the HHRA, ERA and FWM, as well as validation of the CFT model, and include TCL SVOCs, TCL VOCs, TAL metals, a subset of TAL metals in dissolved phase (arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc), titanium, methyl mercury (total and dissolved), hexavalent chromium (dissolved only), butyltins, OC pesticides, cyanide, PAHs, alkyl PAHs, hardness (calculated), TKN, ammonia and total phosphorus. TICs reported in association with the TCL VOC and SVOC analyses could potentially provide information on the need for alternative methods. Group B analyte data will be used to validate the model and in the RI and RAs. Group B will not be analyzed in winter and spring, as potential exposures and biological activity are lower than in other seasons.

Group C - Pathogen analyses are proposed for near-surface samples during one tidal phase or hydrograph stage from five stations in RM 0 - 17.4 of the LPR to determine their relevance in future investigation phases. The five stations, shown in Worksheet #18, were selected by reviewing the sample maps to ensure coverage within the full length of the river, with a focus on areas of where CSOs are present and to provide information regarding the input of pathogens during storm events from off-site sources. Group C will be sampled during spring and summer routine events, the low flow/spring tide event, and both high flow events and includes total coliform and *E. coli*, fecal coliform, fecal streptococci and fecal enterococci bacteria.

Group D - Additional pathogen analyses are proposed for near-surface samples during one tidal phase or hydrograph stage from the five stations in RM 0 - 17.4 of the LPR to determine their relevance in future investigation phases. These five stations are the same stations sampled for Group C analytes, but during fewer sampling events. Group D includes the protozoans *Giardia* and cryptosporidium and will be sampled during summer routine events and both high flow events.

Specific stations designated for the additional Group C and D analyses are noted in Worksheet #18.

Field measurements will include continuous surface to near-bottom measurements of dissolved oxygen, pH, specific conductivity, temperature, and salinity. Physical, chemical, and biological/pathogen tests will be performed on the water samples at the laboratories identified in Worksheet #30 according to methods listed in Worksheet #23.

For the LPRSA RAs and FWM:

- Total concentrations of target analytes are needed for evaluation of the ingestion, dermal contact, direct contact, and inhalation (volatilization) pathways.

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- Dissolved concentrations are needed for evaluation of metals that have water quality criteria that are based on the dissolved fraction. Due to the analytical method, hexavalent chromium will be collected in filtered samples only (i.e., the dissolved fraction).
- To aid in characterizing background conditions, analysis of a subset of samples for bacterial and protozoan pathogens will be included. Characterization will include the variability and short-term (acute) concentrations in human pathogen levels under varying conditions such as flow and seasonality.
- Samples that characterize concentrations in the upper few feet of the water column (e.g., 0-3 ft) will be used for evaluating potential human exposures to COPCs during activities such as swimming or wading. This will be achieved by collecting near surface samples at locations in the tidal part of the river and mid-column samples in the shallower non-tidal part of the river.
- Samples that characterize concentrations throughout the water column are appropriate for evaluating potential ecological exposures to COPECs. This will be achieved by collecting near surface and near bottom samples at locations in the tidal part of the river and mid-column samples in the shallower non-tidal part of the river.

For the LPR/NB CFT model:

- Total concentrations of target analytes are needed for model calibration, validation, and sensitivity analysis, and for developing contaminant loadings to the model. Specific data usage for calibration and validation is provided in the Modeling Work Plan (HydroQual 2006).
- Parameters such as suspended solids, pH, salinity, chlorophyll a, dissolved and particulate organic carbon, major anions (sulfates, chlorides, alkalinity, and sulfide), TDS, temperature, and dissolved oxygen will be measured to aid in characterizing background conditions, as well as for use in developing inputs of adsorbents to the CFT model.

How "good" do the data need to be in order to support the environmental decision?

- The data need to meet project action limits (PALs)) based on the lower of human health and ecological criteria (e.g., national recommended water quality criteria, New Jersey water quality standards). The PALs are presented in Worksheet #15. Not all PALs will be met in the small volume sampling program. These data will be used to inform the development of the high volume sampling program, which will, in part, address small volume data needs where PALs were not achieved. For constituents that meet the PALs, or where frequency of detection is high enough to provide the data necessary to calibrate and validate the CFT model, additional data needs will be fewer. Where PALs are not met or the frequency of detection is not adequate to meet the project quality objectives, constituents will be reviewed for inclusion in the high volume

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sampling program (in prep). The high volume sampling program PQOs will be determined using the results of the small volume program. At a minimum, high volume sampling data will be collected to augment the development of partitioning parameters for use in the CFT model.

- Following the first Routine Event, a subset of 20 samples will be analyzed using rapid turnaround time for the Group A analytes. The results of these samples will serve as the first evaluation of the ability of the data to support the environmental decision. Upon receipt of the data from the laboratory, USEPA, CPG and Tierra will review the data to determine the efficacy of the small volume methods to achieve the PQOs. The CPG and Tierra will provide opinions to USEPA, who will make the final determination. No additional sampling will occur until an agreement is reached on the results of the first event Group A sample analyses.
- Upon completion of the first two Routine Events and throughout the duration of the small volume program, the overall quality of the data will be examined. If groups of chemicals are undetected or rejected, the small volume program will be re-assessed and may be modified.
- The data need to be collected and analyzed in conformance with various USEPA Region 2 quality assurance guidance and manuals (http://www.epa.gov/region2/qa/documents.htm).

How much data are needed (number of samples for each analytical group, matrix, and concentration)?

For the LPRSA RAs and FWM:

- Sample collection is planned throughout the LPRSA (RM 0 to 17.4 and the LPRSA tributaries) and above Dundee Dam.
- The number of samples for the target analytes is planned to be sufficient to calculate average temporal concentrations as described in the next section, including the ability to calculate average concentrations at sampling locations within the potential human or ecological exposure areas in the river. The definition of exposure areas is ongoing as information regarding access, shoreline characteristics, and human uses is collected throughout the RI/FS process. The amount of data being collected from the LPRSA should be sufficient to calculate the necessary exposure point concentrations with statistical confidence. Two hundred (200) samples will be collected from the LPR between RM 0 – 17.4 during the small volume program; 40 samples from each of the five locations. This number of samples is intended to be sufficient to calculate Upper Confidence Limits (UCLs) of average concentrations depending upon the exposure scenario.

For the LPR/NB CFT model:

- Samples collection is planned throughout the LPRSA (RM 0 to 17.4 and the LPRSA tributaries), above Dundee Dam, in Newark Bay and its confluences with the Hackensack River, Arthur Kill and Kill van Kull.

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- The data need to be representative of the various processes in the CFT model such that the diffusive flux rate from the sediment to the water column, resuspension/deposition during storm events, tidal mixing and transport through the salt wedge can be characterized to support the preliminary model calibration and validation. Specifics on the model calibration, validation and sensitivity analysis processes are provided in the Modeling Work Plan (HydroQual 2006).
- A minimum of eight events are proposed to capture data representative of processes (see HydroQual 2006) to be calibrated and validated in the model. Multiple stations are proposed within the LPRSA, above Dundee Dam, and NBSA in order to capture spatial patterns in contaminant concentrations in the study area. It is anticipated that adequate Group B analyte data will be obtained for the model validation from one high flow event.
- The data are intended to provide sufficient temporal (i.e., multiple seasons) coverage to provide an estimate of the contaminant and adsorbent loadings at the model boundaries (i.e., above Dundee Dam, Kill van Kull, Arthur Kill, Hackensack River, Saddle River, Second River, and Third River) during the monitoring events as well as to develop average or time-variable estimates of boundary loadings under current and future conditions.

Where, when, and how should the data be collected/generated?

- The data need to provide spatial coverage of the study area for ecological exposures, and be representative of locations where human exposure is likely to occur based on access, land use, and shoreline characteristics. Data from the sampling locations closest in proximity to an exposure area will be used. Exposure areas are generally described in the PFD (Windward and AECOM 2009).
- The data are intended to address temporal variability and provide an estimate of long-term (annual) average concentrations. Direct contact with and ingestion of surface water may occur anytime during the year, although human exposure is anticipated to be greater during the warmer months of the year. Sampling is intended to characterize seasonal variability and provide for estimation of annual average water column concentrations. Sampling is planned to characterize water column concentrations during the seasons of the year when human and biological activities on the river are expected to be greatest (e.g., late spring, summer, early fall).
- The data are intended to reflect a variety of flow conditions and tidal stages to characterize the variability in influxes and mixing processes in the study area. At a minimum, low flow, high flow and typical flow events will be captured.
- The data are intended to be collected from locations where suspension of solids in the water column is likely to occur under different flow regimes.

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- Samples that characterize concentrations in the upper water column are appropriate for evaluating potential human exposures to COPCs during activities such as swimming or wading. This will be achieved by collecting near surface (i.e., from 3 ft below surface) samples at locations in the tidal part of the river and mid-column samples in the shallower non-tidal part of the river.

To meet the desired data needs, three types of sampling events are proposed: Routine Events, Low Flow/Spring Tide Events and High Flow Events. Data from the sampling events will provide some measure of variability and provide the data needed to estimate long term average concentrations. The following describes the events.

The flow thresholds for the low flow and high flow events were selected from an analysis of the discharge record at Dundee Dam (April 2007 to August 2010). The low flow event threshold was identified by conducting an analysis of the number of events satisfying both the discharge criterion and the spring-tide criterion. The analysis showed that a discharge criterion of <400 cfs sustained over the course of at least 7 days was satisfied multiple times (i.e., 8-12 times per calendar years 2007-2009) in each of the years over the period of record at Dundee Dam. Flows of < 400 cfs maintained for 7 consecutive days and predicted to persist through the sampling period will trigger suitable conditions for the Low Flow Event. This will prevent capture of transient substances from any storm events during the period preceding the sampling event.

The high flow threshold was identified by conducting a return frequency analysis using the available discharge data at Dundee Dam. A flow event with a return period of 3 months (or 4 occurrences per year), was chosen as the flow threshold that can reasonably be expected to be exceeded during the CWCM period. Accordingly, the discharge associated with the 1 in 3 months event at Dundee Dam was calculated to be 3,000 cfs and is proposed as the minimum flow for a high flow event. The high flows (exceeding 3,000 cfs) that trigger the High Flow Events are not sustained high flows, but weather-induced flows. The predicted peak discharge of a weather event should exceed the 3,000 cfs criterion to trigger an event. There is no limitation with respect to the duration of the event, but events of such magnitude may occur over the span of several days.

Routine Events (400 - 3,000 cfs at Dundee Dam)

- Five Routine Events are planned under different seasonal conditions (i.e., one in winter, two in spring, and two in summer).
- One Routine Event will target spring tide conditions and one will target neap tide conditions.
- Data collected during these events combined with preliminary partitioning parameters obtained from scientific literature will be used in the preliminary calibration of the diffusive flux rate from the sediments to the water column, and the deposition of particle-bound contaminants from the water column to the sediment.
- Five Routine Events under low- to medium-flow conditions (400 - 3,000 cfs at Dundee Dam) are proposed to capture data representative of the influxes and mixing processes in the river and the bay, the deposition of particulates from the water column to the sediment, and of the diffusive flux of contaminants from the sediments to the water column.

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- Samples will be collected at the following 17 locations:

  Above Dundee Dam,

  Saddle River,

  Second River,

  Third River,

  Passaic River at RM 10.2 if flow is > 250 cfs at Dundee Dam or RM 13.5 when flow is < 250 cfs at Dundee Dam,

  Passaic River at RM 0,

  Passaic River at RM 1.4,

  Passaic River at RM 6.7 (or approximately one mile downstream of the toe of the salt wedge if flow is < 1,000 cfs at Dundee Dam),

  Passaic River at RM 4.2 (or halfway between the toe of the salt wedge and RM 1.4 up to RM 4.2 if flow is < 1,000 cfs at Dundee Dam),

  Newark Bay North,

  Newark Bay East,

  Newark Bay Northeast,

  Newark Bay Northwest,

  Newark Bay South,

  Kill van Kull,

  Arthur Kill, and

  Hackensack River.

- The locations in Newark Bay North, Newark Bay South, Hackensack River, Kill van Kull, Arthur Kill, RM 10.2, and RM 1.4 are the same locations occupied in the spring 2010 PWCM program. The location at the toe of the salt wedge will be determined from a lookup table identifying the 2 ppth isohaline location as a function of discharge, tidal range (spring/neap), and tidal cycle (high-/low-tide). See Exhibit 1 of Appendix A (FSP Addendum).

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- Samples will be collected 3 ft below the surface and 3 ft from the bottom of the water column at RM 1.4, RM 10.2, the two locations within the salt wedge in the LPR and at all locations in Newark Bay, Kill van Kull, Arthur Kill, and the Hackensack River in order to characterize concentrations through the water column. At all locations with surface and bottom measurements, the bottom sample will be located 3 ft above the bottom at the thalweg. The proposed depths (3 feet off the bottom and three feet from the surface) were selected to with the goal of sampling the relevant layer while avoiding artifacts associated with sampling in close proximity to the sediment bed, the pycnocline, and the water surface. The freshwater stations (Dundee Dam, Saddle River, Second River, and Third River) will be sampled at mid-depth.
- Samples at RM 1.4, RM 10.2, the two locations within the salt wedge in the LPR and at all locations in Newark Bay, Kill van Kull, Arthur Kill, and the Hackensack River will be collected immediately before high water slack and low water slack, as well as near the maximum velocities of ebb and flood tides to characterize contaminant concentrations throughout the tidal cycle. This frequency will be reviewed and discussed with USEPA following the first two events to determine if sampling just high water slack and low water slack will achieve the PQO. Suspended solids are likely to be higher during maximum flood and ebb velocity and lower during periods of slack tide. Should the concentrations vary by more than 50% between tide stages at any station, this may indicate that intra-tidal variability is a driving factor in overall variability. However, should the differences be less than 50%, it is unlikely that intra-tidal variability will impact the model and the frequency of sampling should be revisited. Samples above Dundee Dam and the LPRSA tributaries will be sampled once per event, independent of tide stage.
- The sampling will be quasi-synoptic. Specifically, sample collection will be conducted within approximately a four-day time frame, and near the same phase of the tide for the tidal locations only. Basic meterological conditions such as wind speed, wind direction and precipitation will be monitored and recorded during each sampling event.

High Flow Events (> 3,000 cfs at Dundee Dam)

- Two sampling events are proposed under storm-induced high flow (i.e., not sustained high flow) conditions (>3,000 cfs at Dundee Dam) in order to capture data under conditions in which resuspension of contaminants from the sediment bed and subsequent deposition from the water column are expected to dominate over other transport processes. Storm events rather than elevated base-flow conditions are expected to be the conditions under which such processes dominate. During elevated base-flows where the discharge is high over an extended period of time, the sediment is expected to be armored allowing for little suspension. The criterion of 3,000 cfs is the flow under which the salt front is anticipated to be below RM 1.4 and is the three-month return period event. As described in Appendix A, the high flow event flow criterion may be relaxed if the flows are not achieved such that storm event data may be collected. USEPA will be consulted should the criterion be revisited.
- Data collected during these events are intended to be used in the preliminary calibration of the resuspension fluxes from the sediments to the water column, and the subsequent deposition of particle-bound contaminants from the water column to the sediment. It is also anticipated that during these events there will be a higher loading of suspended sediments (i.e., more contamination per unit weight of suspended solids, as the suspended solids during a storm event would include more bed sediment). The multiple samples during the course of the hydrograph are

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intended to provide a better understanding of the changes in suspended solids and its effect on water column concentrations, especially for the

Dundee Dam station. This is intended to permit the development of a rating curve to predict a loading function depending on the hydrograph for the LPR/NB CFT model.

- Samples will be collected at the following 17 locations:
  - Above Dundee Dam,
  - Saddle River,
  - Second River,
  - Third River,
  - RM 10.2,
  - RM 6.7,
  - RM 4.2,
  - RM 1.4,
  - RM 0,
  - Newark Bay North,
  - Newark Bay East,
  - Newark Bay Northeast,
  - Newark Bay Northwest,
  - Newark Bay South,
  - Kill van Kull,
  - Arthur Kill, and
  - Hackensack River.

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- The locations in Newark Bay North, Newark Bay South, Hackensack, Kill van Kull, Arthur Kill, and RMs 10.2, 6.7, 4.2, and 1.4 are the same locations occupied in the spring 2010 PWCM program.
- Multiple samples are proposed to be collected over the course of the predicted storm hydrograph. As detailed in the FSP (Appendix A), four samples over the predicted storm hydrograph are intended to be collected at most stations. Two samples are proposed for collection on the rising limb on the hydrograph, one near the predicted storm peak, and one on the falling limb of the hydrograph. To capture data on upstream contributions to the LPRSA during storm events, six samples are proposed over the predicted storm hydrograph above Dundee Dam; three on the rising limb, one near predicted peak, and two on the falling limb of the predicted hydrograph. Arthur Kill and Kill van Kull are proposed to be sampled approximately prior to high slack and prior to low slack tide, similar to the Routine Events.
- Above Dundee Dam, the Saddle River, Second River, and Third River stations are proposed to be sampled at mid-depth. The remaining stations will be sampled at both 3 ft below the surface and 3 ft from the bottom of the water column.
- The data are unlikely to be truly synoptic, but the goal will be collect samples throughout the period of the predicted storm hydrograph, somewhat evenly distributed at all locations. Basic meterological conditions such as wind speed, wind direction and precipitation will be monitored and recorded during each sampling event.

Low Flow/Spring Tide Event (< 400 cfs at Dundee Dam)

- One monitoring event is proposed during low-flow conditions (<400 cfs at Dundee Dam) in combination with a spring tide, since this combination is expected to generate the highest tidal energies and tidal mixing as compared to other flow/tide combinations. The 400 cfs criterion is a discharge during which the salt wedge remains upstream of the Primary Erosion Zone.
- Data collected during the event will be used in the calibration of tidally-driven resuspension processes, potential for upstream transport of contaminants through the salt wedge, and the deposition of particle-bound contaminants from the water column to the sediment.
- Samples will be collected at the following nine locations:
  - Above Dundee Dam,
  - Second River,
  - Third River,
  - Saddle River,
  - RM 0,

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  - RM 1.4,
  - one location approximately 1 mile downstream of the toe of the salt wedge,
  - one location halfway between the toe of the salt wedge and RM 1.4, and
  - RM 10.2 (for flows >250 cfs) or RM 13.5 (if flows are < 250 cfs).
- The locations at RM 1.4, RM 10.2 (or 13.5), above Dundee Dam, and the LPRSA tributaries are the same locations occupied in the spring 2010 PWCM program. The locations at the toe of the salt wedge are to be determined from a lookup table identifying the 2 ppth isohaline location as a function of discharge, tidal range (spring/neap), and tidal cycle (high-/low-tide) (see Exhibit 1 of Appendix A).
- Samples will be collected 3 ft below the surface and 3 ft above the bottom at all locations in the LPR RM 0-17.4 in order to characterize concentrations through the water column. The bottom sample will be located 3 ft above the bottom at the thalweg. Samples collected above Dundee Dam and in the LPRSA tributaries will be taken mid-depth.
- Four samples will be collected at each location over the tidal cycle – approximately at low water slack, maximum flood velocity, high water slack, and maximum ebb velocity. Samples above Dundee Dam and the LPRSA tributaries will be sampled once per event, independent of tide stage.
- The low flow locations will be sampled quasi-synoptically, within an approximately four day period. Basic meteorological conditions such as wind speed, wind direction and precipitation will be monitored and recorded during each sampling event.

Proposed Monitoring Locations

The locations sampled during each event will provide spatial coverage in the LPRSA for determination of nature and extent of contamination as well as providing data for exposure point concentrations for the RA. F**u**rther rationale for the specific sampling locations for each of the above events as they relate to the CFT model is given below:

- Dundee Dam – Provide data to estimate loadings to the model.
- Saddle River – Provide data to estimate loadings to the model.
- Second River – Provide data to estimate loadings to the model.
- Third River – Provide data to estimate loadings to the model.
- RM 10.2 or RM 13.5 – PWCM deployment location. Provide data for model calibration and validation.

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- RM 6.7 - PWCM deployment location. Provide data for model calibration and validation during the High Flow Event.
- RM 4.2 – PWCM deployment location. Provide data for model calibration and validation during the High Flow Event.
- Two locations within the salt wedge as described in Exhibit 1 of Appendix A – Provide data for model calibration and validation during the Routine and Low-flow/Spring-tide Events.
- RM 1.4 –PWCM deployment location. Provide data for model calibration and validation and exchange with Newark Bay.
- RM 0 – Provide data at the boundary of the LPR and Newark Bay for model calibration and validation.
- Newark Bay North – Spring 2010 PWCM deployment location. Provide data for model calibration and validation.
- Newark Bay East – Provide data for model calibration and validation at the eastern shore of Newark Bay in subtidal areas where wind-driven sediment resuspension may occur.
- Newark Bay Northeast – Provide data for model calibration and validation at the northern edge of Newark Bay in subtidal areas where wind-driven sediment resuspension may occur.
- Newark Bay Northwest – Provide data for model calibration and validation at the western shore of Newark Bay in subtidal areas where wind-driven sediment resuspension may occur.
- Newark Bay South – Spring 2010 PWCM deployment location. Provide data for model calibration and validation.
- Hackensack River – Spring 2010 PWCM deployment location. Provide data to estimate loadings/exchange with Newark Bay and for model calibration and validation.
- Kill van Kull – Spring 2010 PWCM deployment location. Provide data to estimate loadings/exchange with Newark Bay and for model calibration and validation.
- Arthur Kill – Spring 2010 PWCM deployment location. Provide data to estimate loadings/exchange with Newark Bay and for model calibration and validation.

The water samples will be collected using a peristaltic pump with dedicated tubing. Refer to Appendix A (FSP Addendum) and Appendix B (Field SOPs) for details of field procedures. To capture the specific tidal stage and flow conditions desired by the CFT model calibration, time on-station will be kept to a minimum (e.g., one hour).

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Who will collect and generate the data?

As described in Worksheet #7, AECOM, working on behalf of the CPG, will provide the field sampling coordination and most of the field personnel required to conduct the small volume chemical water column sampling and provide laboratory coordination and support. If necessary, additional field personnel may be provided by de maximis, inc. and/or OSI.

How will the data be reported?

Daily updates of locations and sample collection progress will be communicated as described in Worksheet #6, including communication with the USEPA RPM.

Regular reporting on the progress of the CWCM program will be performed as part of the overall monthly progress reporting for the LPRSA RI/FS and will include the following:

- Brief summary of any field surveys performed during the previous month (type of survey, dates, number of samples collected, issues of note, and deviations from the program QAPP/FSP Addendum).
- Delivery of validated data, processed data, and raw data (as applicable). Requirements for validated data submittals are prescribed by the Region 2 guidance on multimedia electronic data deliverables (EDDs) at http://www.epa.gov/region02/superfund/medd.htm.

Following completion of the entire CWCM program, a data characterization summary report will be prepared that will include the following:

- Summary of the overall monitoring effort including a full description of any deviations from the QAPP/FSP Addendum
- Presentation of a data quality review and summary of data usability
- Summary graphics of monitoring data from the LPRSA and NBSA
- Discussion on achievement of the PQOs and any recommended follow-up investigations

How will the data be archived?

The data will be managed daily and archived per the AECOM DMP (AECOM 2010b) (see Worksheet #29). Electronic data will be archived by ddms.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	VOCs				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-1, C-2	Accuracy/Bias-Contamination	No target compound >Quantitation Limit (QL), no common lab contaminants >5x QL	Method Blank (MB)/Instrument Blank	A
	C-1, C-2	Accuracy/Bias-Contamination	No target compound >QL, no common lab contaminants >5x QL	Trip Blank/Equipment Rinsate Blank	S & A
	C-1, C-2	Accuracy/Bias	Compound-specific percent recoveries (%Rs), see Appendix C-2	Laboratory Control Sample (LCS)	A
	C-1, C-2	Accuracy/Bias	Compound-specific %Rs, see Appendix C-2	Matrix Spike (MS)	S & A
	C-1, C-2	Accuracy/Bias	1,2-Dichloroethane-d4: 59-127%R 4-Bromofluorobenzene: 68-117%R Dibromofluoromethane: 73-122%R Toluene-d8: 78-129%R	Surrogates	A
	C-1, C-2	Accuracy/Bias	Supplier Certified Limits	Performance Evaluation (PE) Sample	A
	C-1, C-2	Precision	Compound-specific relative percent difference (RPD), see Appendix C-2	Matrix Spike Duplicate (MSD)	S & A
	C-1, C-2	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL.	Field Duplicate	S & A
	C-1, C-2	Completeness (Laboratory Analyses)	≥ 90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	SVOCs				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	T-2, T-7	Accuracy/Bias-Contamination	No target compound >QL, no common lab contaminants >5x QL	MB/Instrument Blank	A
	T-2, T-7	Accuracy/Bias-Contamination	No target compound >QL, no common lab contaminants >5x QL	Equipment Rinsate Blank	S & A
	T-2, T-7	Accuracy/Bias	Compound-specific %Rs, see Appendix C-2	LCS	A
	T-2, T-7	Accuracy/Bias	Compound-specific %Rs, see Appendix C-2	MS	S & A
	T-2, T-7	Accuracy/Bias	2-Fluorobiphenyl: 19-107%R 2-Fluorophenol: 10-111%R 2,4,6-Tribromophenol: 16-122%R Nitrobenzene-d5: 23-112%R Phenol-d5: 15-112%R Terphenyl-d14: 10-132%R	Surrogates	A
	T-2, T-7	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	T-2, T-7	Precision	Compound-specific RPD, see Appendix C-2	MSD	S & A
	T-2, T-7	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	T-2, T-7	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	PAHs and Alkyl PAHs (Low Resolution Mass Spectrometry [LRMS] – SIM)				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	T-4, T-3	Accuracy/Bias-Contamination	No target compound >QL	MB/Instrument Blank	A
	T-4, T-3	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	T-4, T-3	Accuracy/Bias	60-140%R	LCS	A
	T-4, T-3	Accuracy/Bias	60-140%R	MS	S & A
	T-4, T-3	Precision	RPD<30%	MSD	S & A
	T-4, T-3	Accuracy/Bias	60-140%R in MB and LCS 30-120%R in field samples	Labeled compounds	A
	T-4, T-3	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	T-4, T-3	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	T-4, T-3	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	OC Pesticides				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	T-11	Accuracy/Bias - Contamination	No target compound >QL	MB/Instrument Blank	A
	T-11	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	T-11	Accuracy/Bias	50-120%R, except for 4,4'-DDD 24-123%; 2,4'-DDE 24-123%; Endrin Aldehyde 50-170%; Endrin Ketone 50-134%;	On-going Precision and Recovery (OPR) sample (equivalent to LCS sample)	A
	T-11	Accuracy/Bias	50-150%R	MS	S & A
	T-11	Precision	RPD<30%	MSD	S & A
	T-11	Accuracy/Bias	Per EPA 1699 Table 5	Labeled compounds	A
	T-11	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or QCCS Sample Analysis[d]	A
	T-11	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	T-11	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet#31 for additional details of the program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	PCBs – Congeners and Homologs				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	T-6, T-5	Accuracy/Bias-Contamination	No target compound > QL	MB/Instrument Blank	A
	T-6, T-5	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	T-6, T-5	Accuracy/Bias	50-150%R Toxics/Level of Chlorination (LOC) congeners 40-160%R all other congeners	OPR sample (equivalent to LCS)	A
	T-6, T-5	Accuracy/Bias	50-150%R Toxics/LOC congeners 40-160%R all other congeners	MS	S & A
	T-6, T-5	Precision	RPD <30%	MSD	S & A
	T-6, T-5	Accuracy/Bias	30-140%R	Labeled compounds	A
	T-6, T-5	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or QCCS Sample Analysis[d]	A
	T-6, T-5	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	T-6, T-5	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	PCDD/PCDFs				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	A-1	Accuracy/Bias-Contamination	No target compound >QL	MB/Instrument Blank	A
	A-1	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	A-1	Accuracy/Bias	%D for RRF vs ICAL ≤ 20% except labeled analogs ≤ 30%	Batch control spike (BCS_3)[d]	A
	A-1	Accuracy/Bias	50-150%R	MS	S & A
	A-1	Precision	RPD ≤25%	MSD	S & A
	A-1	Accuracy/Bias	Compound-specific %Rs, see SOP	Labeled Compounds	A
	A-1	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or QCCS Sample Analysis[e]	A
	A-1	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	A-1	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] The BCS_3 is a special QC sample prepared with each 20 sample batch that combines all the spike solutions used on field samples with target analytes. It is analyzed at the beginning and end of each analytical sequence containing the associated samples.
[e] Refer to Worksheet#31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	Metals (total and dissolved) by Inductively Coupled Plasma/ Atomic Emission Spectroscopy (ICP/AES)				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-4, C-3	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-4, C-3	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-4, C-3	Accuracy/Bias	Compound-specific %Rs, see Appendix C-2	LCS	A
	C-4, C-3	Accuracy/Bias	Compound-specific %Rs, see Appendix C-2	MS	S & A
	C-4, C-3	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	C-4, C-3	Precision	RPD ≤20%	Laboratory Duplicate	A
	C-4, C-3	Precision	RPD ≤20% if both samples are >5x QL or absolute difference between concentrations <QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-4, C-3	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	Metals (total and dissolved) by Inductively Coupled Plasma – Mass Spectrometry (ICP/MS)				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-3, C-5, C-6	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-3, C-5, C-6	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-3, C-5, C-6	Accuracy/Bias	Compound-specific %Rs, see Appendix C-2	LCS	A
	C-3, C-5, C-6	Accuracy/Bias	Compound-specific %Rs, see Appendix C-2	MS	S & A
	C-3, C-5, C-6	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	C-3, C-5, C-6	Precision	RPD ≤20%	Laboratory Duplicate	A
	C-3, C-5, C-6	Precision	RPD ≤20% if both samples are >5x QL or absolute difference between concentrations <QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-3, C-5, C-6	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	Mercury (Low Level, total and dissolved)				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	B-1	Accuracy/Bias-Contamination	Average MB <2x Method Detection Limit (MDL) and standard deviation <0.67x MDL or <0.1x the concentration of project samples	MB	A
	B-1	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	B-1	Accuracy/Bias	80 -120%R	LCS	A
	B-1	Accuracy/Bias	71 -125%R	MS	S & A
	B-1	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	B-1	Precision	RPD ≤24%	MSD	S & A
	B-1	Precision	RPD ≤24%	Laboratory Duplicate	A
	B-1	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	B-1	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet#31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	Methyl Mercury (total and dissolved)				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	B-2	Accuracy/Bias-Contamination	Average MB <0.045 nanograms per liter (ng/L) and standard deviation ≤0.015 ng/L or <0.1x the concentration of project samples	MB	A
	B-2	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	B-2	Accuracy/Bias	65-135%R	MS	S & A
	B-2	Precision	RPD ≤35%	MSD	S & A
	B-2	Precision	RPD ≤35% (or ± QL if results are ≤5x the QL)	Laboratory Duplicate	A
	B-2	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	B-2	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	B-2	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	Hexavalent Chromium (dissolved)				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-15	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-15	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-15	Accuracy/Bias-Contamination	No target compound >QL	Field Buffer Blank	S & A
	C-15	Accuracy/Bias	90-110%R	LCS	A
	C-15	Accuracy/Bias	90-110%R	MS	S & A
	C-15	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	C-15	Precision	RPD ≤20%	MSD	S & A
	C-15	Precision	RPD ≤20%	Laboratory Duplicate	A
	C-15	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-15	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet#31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	Butyltins				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-8, C-7	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-8, C-7	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-8, C-7	Accuracy/Bias	Tripropyltin: 24-142%R	Surrogate	A
	C-8, C-7	Accuracy/Bias	Monobutyltin: 40-165%R Dibutyltin: 18-128%R Tributyltin: 30-120%R Tetrabutyltin: 24-104%R	LCS	A
	C-8, C-7	Accuracy/Bias	Monobutyltin: 40-165%R Dibutyltin: 18-128%R Tributyltin: 30-120%R Tetrabutyltin: 24-104%R	MS	S & A
	C-8, C-7	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	C-8, C-7	Precision	RPD ≤30%	MSD	S & A
	C-8, C-7	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-8, C-7	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet#31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	General Chemistry - Sulfide				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-14	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-14	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-14	Accuracy/Bias	74-122%R	LCS	A
	C-14	Accuracy/Bias	74-122%R	MS	S & A
	C-14	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	C-14	Precision	RPD ≤20%	Laboratory Duplicate	A
	C-14	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-14	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet#31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	General Chemistry – TDS				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-19	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-19	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-19	Accuracy/Bias	85-115%R	LCS	A
	C-19	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	C-19	Precision	RPD ≤10%	Laboratory Duplicate	A
	C-19	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-19	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet#31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	General Chemistry – Ammonia-N				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-9	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-9	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-9	Accuracy/Bias	90-112%R	LCS	A
	C-9	Accuracy/Bias	90-112%R	MS	S & A
	C-9	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	C-9	Precision	RPD ≤20%	Laboratory Duplicate	A
	C-9	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-9	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	General Chemistry – Cyanide				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-10	Accuracy/Bias-Contamination	No detection >QL	MB	A
	C-10	Accuracy/Bias-Contamination	No detection >QL	Equipment Rinsate Blank	S & A
	C-10	Accuracy/Bias	83 – 116%R	LCS	A
	C-10	Accuracy/Bias	35 -144%R	MS	S & A
	C-10	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	C-10	Precision	RPD ≤20%	Laboratory Duplicate	A
	C-10	Precision	RPD ≤20% if both samples are >5x QL or absolute difference between concentrations <QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-10	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	General Chemistry – TKN				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-12	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-12	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-12	Accuracy/Bias	78-117%R	LCS	A
	C-12	Accuracy/Bias	37-158%R	MS	S & A
	C-12	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	C-12	Precision	RPD ≤20%	Laboratory Duplicate	A
	C-12	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-12	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheets #31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	General Chemistry – Total Phosphorus				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-11	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-11	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-11	Accuracy/Bias	88- 113%R	LCS	A
	C-11	Accuracy/Bias	50 -144%R	MS	S & A
	C-11	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	C-11	Precision	RPD ≤20%	Laboratory Duplicate	A
	C-11	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-11	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	General Chemistry –TOC and DOC				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-13, C-16	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-13, C-16	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-13, C-16	Accuracy/Bias	90-109%R	LCS	A
	C-13, C-16	Precision	RPD≤ 20%	LCS Duplicate (LCSD)	A
	C-13, C-16	Accuracy/Bias	≤110% of the unspiked sample	Inorganic Carbon Spike	A
	C-13, C-16	Accuracy/Bias	80-120%R	MS	A
	C-13, C-16	Precision	RPD≤ 20%	MSD	A
	C-13, C-16	Accuracy/Bias	Supplier C ertified Limits	PE Sample Data Review or Sample Analysis[d]	A
	C-13, C-16	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-13, C-16	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	General Chemistry – POC				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-16	Accuracy/Bias-Contamination	<0.025 mg/L or <10% of the concentration in the associated samples	MB	A
	C-16	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-16	Accuracy/Bias	95-105%R or within the manufacturer's control limits	LCS	A
	C-16	Accuracy/Bias	85-115%R	Laboratory Fortified Blank (LFB)	A
	C-16	Precision	RPD ≤20% if both samples are >10x QL	Laboratory Duplicate	A
	C-16	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-16	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	General Chemistry – Suspended Sediment Concentration (SSC)				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-17	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-17	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-17	Precision	RPD ≤20%	Laboratory Duplicate	A
	C-17	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-17	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	General Chemistry – Alkalinity				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-20	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-20	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-20	Accuracy/Bias	94-106%R	LCS	A
	C-20	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	C-20	Precision	RPD ≤20%	Laboratory Duplicate	A
	C-20	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-20	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	General Chemistry – Sulfate and Chloride				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-21	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-21	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-21	Accuracy/Bias	90-110%R	LCS	A
	C-21	Accuracy/Bias	80-120%R	MS	S & A
	C-21	Accuracy/Bias	Supplier Certified Limits	PE Sample Data Review or Sample Analysis[d]	A
	C-21	Precision	RPD ≤20%	Laboratory Duplicate	A
	C-21	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-21	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet#31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	General Chemistry – Chlorophyll a				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	C-22	Accuracy/Bias-Contamination	No target compound >QL	MB	A
	C-22	Accuracy/Bias-Contamination	No target compound >QL	Filtration Blanks	A
	C-22	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blank	S & A
	C-22	Accuracy/Bias	91-108%R	LCS	A
	C-22	Accuracy/Bias	Supplier Certified Limits	PE Sample	A
	C-22	Precision	RPD ≤20%	Laboratory Duplicate	A
	C-22	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	S & A
	C-22	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet#31 for additional details of the PE program.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	Bacteria – Total coliform and *Escherichia coli* (*E. Coli*)				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	E-1	Accuracy/Bias	Yellow color (coliform) with fluorescence (*E.coli*)	Control Sample	A
	E-1	Accuracy/Bias-Contamination	No color, no fluorescence	MB	A
	E-1	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	A
	E-1	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	Microbiological – Fecal coliform				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	E-2	Accuracy/Bias	Blue colored colonies	Control Sample	A
	E-2	Accuracy/Bias-Contamination	No blue colored colonies	MB	A
	E-2	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	A
	E-2	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	Microbiological – Fecal Streptococci and Fecal Enterococci				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	E-3, E-4	Accuracy/Bias	Pink-red colored colonies	Control Sample	A
	E-3, E-4	Accuracy/Bias-Contamination	No pink-red colored colonies	MB	A
	E-3, E-4	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	A
	E-3, E-4	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	Microbiological – Protozoans (Cryptosporidium)				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	S-1	Accuracy/Bias-Contamination	No detected oocysts	MB	A
	S-1	Accuracy/Bias	11-100%R	Control Sample	A
	S-1	Accuracy/Bias	13-111%R	MS	A
	S-1	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	A
	S-1	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	Water				
Analytical Group[a]	Microbiological – Protozoans (*Giardia*)				
Concentration Level	Low				
Sampling Procedure[b]	**Analytical Method/SOP**[c]	**DQI**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-FI-04	S-1	Precision	RPD ≤30%	Laboratory Duplicates	S&A
	S-1	Accuracy/Bias-Contamination	No detected cysts	MB	A
	S-1	Accuracy/Bias	14-100%R	LCS	A
	S-1	Accuracy/Bias	14-118%R	MS	A
	S-1	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Field Duplicate	A
	S-1	Completeness (Laboratory Analyses)	≥90%	Data Completeness Check	S & A

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Work Performed by Tierra Solutions, Inc. in LPRSA				
Tide Gage Measurement	Tierra Solutions, Inc. 1995 to 1996 Sediment Sampling and Source Identification Program: Inventory and Overview Report of Historical Data: Revision 0 Appendix I. Tierra Solutions Inc. June 2004.	Tierra Solutions, Inc., Water level fluctuations, April 14, 1995 to June 11, 1996 (partial), 3 gages RM: 0.9–7.8	Provides characterization of water level variation.	Does not cover all flow conditions. Covers only RM 0.9 – 7.8. Does not include concurrent water quality data. See PWCM QAPP (AECOM 2010a) for data quality review.
Current Cross-Section Measurement	Tierra Solutions, Inc. 1995 to 1996 Sediment Sampling and Source Identification Program: Inventory and Overview Report of Historical Data: Revision 0 Appendix I. Tierra Solutions Inc. June 2004.	Tierra Solutions, Inc., 8 Velocity cross-sections periodically surveyed between July 7, 1995 and May 22, 1996 during different tide phases RM: 0.5–7.9	Provides characterization under limited set of conditions.	Does not cover all flow conditions. Covers only RM 0.5 – 7.9. Does not include concurrent water quality data. See PWCM QAPP (AECOM 2010a) for data quality review.
Moored Current Profile Measurement	Tierra Solutions, Inc. 1995 to 1996 Sediment Sampling and Source Identification Program: Inventory and Overview Report of Historical Data: Revision 0 Appendix I. Tierra Solutions Inc. June 2004.	Tierra Solutions, Inc., Point velocity meters, July 26, 1995 to May 22, 1996 (partial), 3 gages RM: 1.4–6.8	Provides characterization under limited set of conditions.	Does not cover all flow conditions. Covers only RM 1.4 – 6.8. Does not include concurrent water quality data. See PWCM QAPP (AECOM 2010a) for data quality review.
Salinity Cross-Section Measurement	Tierra Solutions, Inc. 1995 to 1996 Sediment Sampling and Source Identification Program: Inventory and Overview Report of Historical Data: Revision 0 Appendix I. Tierra Solutions Inc. June 2004.	Tierra Solutions, Inc., 8 Salinity cross-sections periodically surveyed between July 20, 1995 and May 22, 1996, during different tide phases RM: 0.5–7.9	Provides characterization under limited set of conditions.	Does not capture movement of salt wedge with flow conditions. Does not include concurrent water quality data. See PWCM QAPP (AECOM 2010a) for data quality review.

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Work Performed by MPI in LPRSA				
Moored Current Profile Measurement	MPI 2004 to 2005 No Formal Report www.ourpassaic.org Accessed January 20, 2008.	MPI, Vertical velocity profile, November 2, 2004, to October 11, 2005 (partial), 3 gages RM: 8.6–11.5	Provides characterization under limited set of conditions.	Dataset is incomplete with substantial time periods and spatial locations not included. See PWCM QAPP (AECOM 2010a) for data quality review.
Moored Salinity Measurement	MPI 2004 to 2005 No Formal Report www.ourpassaic.org Accessed January 20, 2008.	MPI, surface and bottom salinity conditions, November 30, 2004 to September 20, 2005, 3 gages RM: 8.6–11.5	Provides characterization under limited set of conditions.	Meters present only between RM 8.6 and RM 11.5. See PWCM QAPP (AECOM 2010a) for data quality review.
Moored Turbidity Measurement	MPI 2004 to 2005 No Formal Report www.ourpassaic.org Accessed January 20, 2008.	MPI, surface and bottom suspended solids conditions, November 30, 2004 to September 20, 2005 (partial), 3 gages RM: 8.6–11.5	Provides characterization under limited set of conditions.	Meters present only between RM 8.6 and RM 11.5. See PWCM QAPP (AECOM 2010a) for data quality review.
Dissolved/total metals, Dissolved/particulate PCBs, pesticides, POC, DOC, Chlorine (Cl), Bromine (Br), Total Suspended Solids (TSS)	MPI, pilot dredging study Passaic River Estuary Management Information System (PREmis) database	Collected December 2005 in Harrison Reach only.	Provides characterization under limited set of conditions.	Very limited temporal or spatial coverage or limited/lacking corresponding hydrodynamic information.
PCDD/PCDFs, pesticides, PCBs, TSS	MPI, HOC Sampling Method Validation Study (HSMVS) survey project PREmis database	Collected October/November 2005	Provides preliminary data on ranges of concentrations, evaluation of sampling methodology.	Limited temporal and spatial coverage.
Metals, pesticides, VOCs, SVOCs, herbicides, nutrients, Biological Oxygen Demand (BOD), DOC, Chlorophyll a , TSS	MPI Small Volume Composite Grab (SVCG) survey project PREmis database	Collected November 2005	Provides preliminary data on ranges of concentrations, evaluation of sampling methodology.	Limited temporal and spatial coverage.

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Empirical Mass Balance Model (EMBM) Sampling Program - Water Column Suspended Sediment Sampling on Tributaries and Upper Passaic River	PREmis database	Collected Winter 2008	Provides preliminary data on ranges of concentrations, evaluation of sampling methodology	Limited temporal and spatial coverage. No report available providing methodology.
Work Performed by Rutgers University Coastal Ocean Observation Lab in LPRSA and/or NBSA				
Moored Salinity Measurement	Rutgers 2004 to 2005 No Formal Report www.marine.rutgers.edu/cool/~~passaic/~~ Accessed January 20, 2008	Rutgers, surface and bottom salinity, August 18, 2004 to September 12, 2005, 5 moorings RM: 1.0–7.8	Provides characterization under limited set of conditions	Does not cover all flow conditions. See PWCM QAPP (AECOM 2010a) for data quality review.
Moored Current Profile Measurement	Rutgers 2004 to 2005 No Formal Report www.marine.rutgers.edu/cool/~~passaic/~~ Accessed January 20, 2008	Rutgers, Vertical velocity profile, August 18, 2004 to September 3, 2005 RM: 2.8	Provides insight to appropriate mooring locations for future synoptic data	Available for single location at approximately RM 3. See PWCM QAPP (AECOM 2010a) for data quality review.
Salinity Profile Transect Measurement	Rutgers 2004 to 2005 No Formal Report www.marine.rutgers.edu/cool/~~passaic/~~ Accessed January 20, 2008	Rutgers, 13 Salinity transects, June 23, 2004 to August 18, 2005. RM: 0.0–8.0	Provides characterization under limited set of conditions	Covers only lower 8 miles of river. Synoptic nature of data unconfirmed. See PWCM QAPP (AECOM 2010a) for data quality review.
Current Profile Transect Measurement	Rutgers 2004 to 2005 No Formal Report www.marine.rutgers.edu/cool/~~passaic/~~ Accessed January 20, 2008	Rutgers, Velocity cross-section, September 23, 2004 to August 18, 2005, 13 transects RM: 0.0–8.0	Will not be used	Data not corrected for magnetic influence on instrumentation compass, or used to monitor dye study, therefore not synoptic. See PWCM QAPP (AECOM 2010a) for data quality review.

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Moored Turbidity Measurement	Rutgers 2004 to 2005 No Formal Report www.marine.rutgers.edu/cool/passaic/ Accessed January 20, 2008	Rutgers, surface and bottom suspended solids conditions, August 18, 2004 to September 12, 2005 (partial), 5 moorings RM: 1.0–6.7	Will not be used	Substantial instrumentation fouling due to debris in river. See PWCM QAPP (AECOM 2010a) for data quality review.
Moored Turbidity Measurement	Rutgers 2004 to 2005 No Formal Report www.marine.rutgers.edu/cool/passaic/ Accessed January 20, 2008	Rutgers, Vertical turbidity profile, August 18, 2004 – September 3, 2005 RM: 2.8	Provides characterization under limited set of conditions	Data available only for RM 3. See PWCM QAPP (AECOM 2010a) for data quality review.
Moored Acoustic Doppler Current Profiler (ADCP) Measurements	Sommerfield and Chant 2010	Sommerfield and Chant, April 2008 – March 2009. 5 moorings: LPR, Hackensack River, mid-Newark Bay, Kill van Kull, Arthur Kill	Characterization of flows, salinity and solids movement in the NBSA	Covers a range of flow events, but the complete set of concurrent turbidity data (for estimating loads into and out of the system) was not recovered.
Moored Turbidity Measurements	Sommerfield and Chant 2010	Sommerfield and Chant, April 2008 – March 2009. 5 moorings: LPR, Hackensack River, mid-Newark Bay, Kill van Kull, Arthur Kill	Characterization of flows, salinity and solids movement in the NBSA	Surface turbidity data in the Kills was corrected due to fouling, limiting the ability to use the data in model development.
Water Column TSS	Sommerfield and Chant 2010	Sommerfield and Chant, April 2008 – March 2009. Collected along transects at the locations of the 5 moorings: LPR, Hackensack River, mid-Newark Bay, Kill van Kull, Arthur Kill	Characterization of flows, salinity and solids movement in the NBSA	Data will be reviewed for quality, completeness and sufficiency for NBSA characterization when publically available

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Work performed by various investigators in LPRSA and/or NBSA				
Stream Flow	United States Geological Service (USGS) Gage 01389500 – Passaic River at Little Falls, NJ No Formal Report http://waterdata.usgs.gov/nj/nwis/nwisman/?site_no=01389500&agency_cd=USGS	USGS Daily average stream flow August 1897 – present	Record of historical flows, development of flow frequency statistics, and evaluation of other water column measurements	No limitations
Stream Flow	USGS Gage 01389890 – Passaic River at Dundee Dam at Clifton, NJ No Formal Report http://waterdata.usgs.gov/nj/nwis/inventory/?site_no=01389890&amp	USGS Daily average stream flow April 2007 – present	Evaluation of other water column measurements, compare with Little Falls data	Limited record
Various Water Quality Parameters	Tierra Solutions, Inc. (2004) for a complete summary of historic data collection programs	Various public and private entities	Data provides historic context, but no direct application.	Limited spatial and temporal extent, potentially dated laboratory methods, many studies not performed to CERCLA standards.
HOCs, Metals, carbon, TSS and ancillary (loading) data	NY/NJ HEP Contamination Assessment Reduction Project (CARP) program. See NY/NJ HEP website http://www.carpweb.org/main.html.	Same as data source	May use NY/NJ HEP data for comparative purposes	Very limited temporal or spatial coverage or limited/lacking corresponding hydrodynamic information

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) Summary of Project Tasks

Sampling Tasks: Refer to FSP Addendum (Appendix A)

The proposed investigation for the small volume phase of the RI CWCM Data Collection includes collection of water samples from the LPRSA (including the three major LPRSA tributaries), above Dundee Dam, and the NBSA (Newark Bay and its confluences with Arthur Kill, Kill van Kull and Hackensack River). Eight sampling events that cover a variety of LPRSA flow conditions and tidal stages are proposed. Seven sampling events will include sampling a variety of flow conditions and tidal stages in the NBSA. Samples will be collected from the water column at each station using a peristaltic pump and tubing. Samples collected from freshwater areas including above Dundee Dam and the three LPRSA tributaries will be collected from mid-depth in the water column. At all other stations, including where the salt wedge is typically or always present, samples will be collected from two depths: 3 ft above bottom and 3 ft below the surface. The depth will be measured using a graduated line, depth gage and the vessel fathometer. Locations are presented in Worksheet #18 and Appendix A (Figure 1 and Exhibit 1).

At each location, water will be collected for analysis of target analytes divided into four analytical groups that includes, at a subset of stations, analysis of biological pathogens (see Worksheet #18). Water samples will be whole, unfiltered water, except for the samples collected for the dissolved phase concentrations of a subset of metals. Filtration for these metals will be conducted in the field due to short holding times associated with unpreserved samples. As indicated in SOP LPR-FI-06, “clean hands/dirty hands” techniques will be used to sample and filter the metals samples, including mercury and methyl mercury.

Three types of sampling events are planned for the small volume sampling program: Routine, Low Flow/Spring Tide and High Flow Events. These events have been planned to provide a variety of conditions for calibration and validation of the CFT model, as well as temporal variability (i.e., multiple seasons) for the RAs and FWM. The locations selected for the program provide both spatial coverage of the LPRSA and NBSA, and in some instances are located such that they reflect specific conditions relative to the location of the salt wedge during different flow regimes. This information will allow calibration and validation of the CFT model.

Analysis Tasks: As the initial phase of the overall RI/FS chemical water column characterization, this investigation will include a wide range of analyses. Four groups of analyses are proposed:

Group A - A list of target physical and inorganic and organic chemical analyses is proposed for the full set of stations and depths (refer to Worksheet #15). These analytes will be measured in all samples during each of the eight events and will be used primarily for estimation of EPCs for the HHRA, ERA and FWM, and in the CFT model calibration. This analyte list is consistent with the Modeling Work Plan (HydroQual, 2006) and include PCDD/PCDFs, PCB congeners and homologs, mercury (total and dissolved), and supporting parameters to be used in the CFT model (i.e., DOC, POC, SSC, TOC, chlorophyll a, alkalinity, sulfate, total sulfide, TDS, and chloride). Total and dissolved cadmium, copper and lead will also be included in the Group A analyte list.

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) Summary of Project Tasks

Group B - A comprehensive list of physical and inorganic and organic chemical analyses is proposed for the full set of stations and depths for a subset of sampling events (refer to Worksheet #15). These parameters will be used to support EPC calculations for the HHRA, ERA and FWM, as well as validation of the CFT model and include TCL SVOCs, TCL VOCs, TAL metals, a subset of TAL metals in dissolved phase (arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc), titanium, methyl mercury (total and dissolved), hexavalent chromium (dissolved only), butyltins, OC pesticides, cyanide, PAHs, alkyl PAHs, hardness (calculated), TKN, ammonia and total phosphorus.

Group C - Pathogen analyses are proposed for near-surface samples during one tidal phase or hydrograph stage from five stations in RM 0 - 17.4 of the LPR to determine their relevance in future investigation phases. The five stations, shown in Worksheet #18, were selected by reviewing the sample maps to ensure coverage within the full length of the river, with a focus on areas of where CSOs are present and to provide information regarding the input of pathogens during storm events from off-site sources. Group C will be sampled during spring and summer routine events, the low flow/spring tide event, and both high flow events and includes total coliform and *E. coli*, fecal coliform, fecal streptococci and fecal enterococci bacteria.

Group D - Additional pathogen analyses are proposed for near-surface samples during one tidal phase or hydrograph stage from five stations in RM 0 - 17.4 of the LPR to determine their relevance in future investigation phases. Group D includes the protozoans *Giardia* and cryptosporidium and will be sampled during summer routine events and both high flow events.

Specific stations designated for the additional Group C and D analyses are noted in Worksheet #18

Field measurements will include continuous surface to near-bottom measurements of dissolved oxygen, pH, specific conductivity, temperature, and salinity. Physical, chemical, and biological/pathogen tests will be performed on the water samples at the fixed laboratories identified in Worksheet #30 according to methods listed in Worksheet #23.

Quality Control Tasks: QC samples have been defined for the field and laboratory efforts. Field QC samples are summarized on Worksheet #20; laboratory QC samples are summarized on Worksheet #28.

Secondary Data: All relevant secondary/historical data are summarized on Worksheet #13.

Data Management Tasks: AECOM's DMP (AECOM 2010c) covers all field-collected and laboratory-generated records/data. The handling of records and data are summarized on Worksheet #29.

Documentation and Records: Project related records (field, sample transfer/chain of custody, laboratory) are summarized on Worksheet #29.

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) Summary of Project Tasks

Assessment/Audit Tasks: Field and laboratory audits are scheduled in accordance with Worksheet #31.

Data Review Tasks: Field data will be reviewed as described in Worksheet #34. Laboratories are contractually required to verify all laboratory data including EDDs as summarized in Worksheet #34. Data validation and usability assessments will be conducted as detailed in Worksheets #35, 36, and 37.

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Matrix: Water
Analytical Group: TCL VOCs
Concentration Level: Low

Analyte	CAS Number	PAL[a] U	nits	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	MDLs	QLs
1,1,1-Trichloroethane	71556	11	ug/L	[11]	0.5	NA	5	0.08	0.5
1,1,2,2-Tetrachloroethane	79345	0.067	ug/L	[6]	0.5	NA	5	**0.16**	**0.5**
1,2,2-Trichloro-1,1,2-trifluoroethane	76131	5900	ug/L	[6]	0.5	NA	5	0.13	0.5
1,1,2-Trichloroethane	79005	0.042	ug/L	[6]	0.5	NA	5	**0.14**	**0.5**
1,1-Dichloroethene	75354	4.7	ug/L	[1]	0.5	NA	5	0.077	0.5
1,1-Dichloroethane	75343	2.4	ug/L	[6]	0.5	NA	5	0.074	0.5
1,2,3-Trichlorobenzene	87616	2.9	ug/L	[6]	2	NA	5	0.11	2
1,2,4-Trichlorobenzene	120821	0.41	ug/L	[6]	2	NA	5	0.096	**2**
1,2-Dibromoethane	106934 0.	0065	ug/L	[6]	2	NA	5	**0.2**	**2**
1,2-Dibromo-3-chloropropane	96128	0.00032	ug/L	[6]	2	NA	5	**0.1**	**2**
1,2-Dichlorobenzene	95501	14	ug/L	[11]	0.5	NA	5	0.12	0.5
1,2-Dichloroethane	107062	0.15	ug/L	[6]	0.5	NA	5	0.08	**0.5**
1,2-Dichloropropane	78875	0.39	ug/L	[6]	0.5	NA	5	0.095	**0.5**
1,3-Dichlorobenzene	541731	37	ug/L	[6]	0.5	NA	5	0.1	0.5
1,4-Dichlorobenzene	106467	0.43	ug/L	[6]	0.5	NA	5	0.12	**0.5**
2-Butanone	78933	710	ug/L	[6]	20	NA	5	1.9	20
2-Hexanone	591786	4.7	ug/L	[6]	20	NA	5	2.7	**20**
4-Methyl-2-pentanone	108101	170	ug/L	[11]	20	NA	5	2.6	20
Acetone	67641	1500	ug/L	[11]	20	NA	5	3.3	20
Benzene	71432	0.15	ug/L	[1]	0.5	NA	5	0.054	**0.5**

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a] U	nits	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	MDLs	QLs
Bromochloromethane	74975	0.55	ug/L	[1][3]	0.5	NA	5	0.16	0.5
Bromodichloromethane	75274	0.12	ug/L	[6]	0.5	NA	5	0.091	**0.5**
Bromoform	75252	4.3	ug/L	[1][3]	0.5	NA	5	0.16	0.5
Bromomethane	74839	0.87	ug/L	[6]	0.5	NA	5	0.09	0.5
Carbon disulfide	75150	0.92	ug/L	[11]	0.5	NA	5	0.055	0.5
Carbon tetrachloride	56235	0.23	ug/L	[3]	0.5	NA	5	0.096	**0.5**
Chlorobenzene	108907	9.1	ug/L	[6]	0.5	NA	5	0.11	0.5
Chloroethane	75003	2100	ug/L	[6]	0.5	NA	5	0.16	0.5
Chloroform	67663	0.19	ug/L	[6]	0.5	NA	5	0.072	**0.5**
Chloromethane	74873	19	ug/L	[6]	0.5	NA	5	0.068	0.5
cis-1,2-Dichloroethene	156592	7.3	ug/L	[6]	0.5	NA	5	0.067	0.5
cis-1,3-Dichloropropene	10061015	0.34	ug/L	[1][3]	0.5	NA	5	0.18	**0.5**
Cyclohexane	110827	1300	ug/L	[6]	1	NA	5	0.1	1
Dibromochloromethane	124481	0.15	ug/L	[6]	0.5	NA	5	0.14	**0.5**
Dichorodifluoromethane	75718	20	ug/L	[6]	0.5	NA	5	0.13	0.5
Ethylbenzene	100414	1.5	ug/L	[6]	0.5	NA	5	0.05	0.5
Isopropylbenzene	98828	68	ug/L	[6]	2	NA	5	0.051	2
Methyl acetate	79209	3700	ug/L	[6]	1	NA	5	0.15	1
Methyl tert-Butyl Ether	1634044	12	ug/L	[6]	0.5	NA	5	0.11	0.5
Methylcyclohexane	108872	NA	ug/L	NA	1	NA	5	0.086	1
Methylene chloride	75092	2.5	ug/L	[1]	2	NA	5	0.1	2
Styrene	100425	100	ug/L	[5]	0.5	NA	5	0.089	0.5
Tetrachloroethene	127184	0.11	ug/L	[6]	0.5	NA	5	0.099	**0.5**

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a] U	nits	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	MDLs	QLs
Toluene	108883	9.8	ug/L	[11]	0.5	NA	5	0.052	0.5
trans-1,2-Dichloroethene	156605	11	ug/L	[6]	0.5	NA	5	0.057	0.5
trans-1,3-Dichloropropene	10061026	0.34	ug/L	[1][3]	0.5	NA	5	0.068	**0.5**
Trichloroethene	79016	1	ug/L	[1]	0.5	NA	5	0.1	0.5
Trichlorofluoromethane	75694	130	ug/L	[6]	0.5	NA	5	0.12	0.5
Vinyl chloride	75014	0.016	ug/L	[6]	0.5	NA	5	**0.075**	**0.5**
Xylenes (total)	1330207	1.8	ug/L	[11]	0.5	NA	5	0.09	0.5
Tentatively Identified Compounds	NA	NA	ug/L	NA	NA	NA	NA	NA	NA

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Matrix: Water
Analytical Group: TCL SVOCs
Concentration Level: Low

Analyte	CAS Number	PAL[a] U	nits	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e,g]	
						MDLs	Method QLs	MDLs	QLs
1,1'-Biphenyl	92524	0.083	ug/L	[6]	1	NA	10	0.04	**1**
1,2,4,5-Tetrachlorobenzene	95943	0.97	ug/L	[1][3]	1	NA	10	0.07	**1**
1,4-Dioxane by modified EPA Method 8270 SIM	123911	0.67	ug/L	[6]	0.2	NA	10	0.14	**2**
2,3,4,6-Tetrachlorophenol	58902	110	ug/L	[6]	1	NA	10	0.14	1
2,4,5-Trichlorophenol	95954	370	ug/L	[6]	1	NA	10	0.15	1
2,4,6-Trichlorophenol	88062	0.58	ug/L	[1]	1	NA	10	0.18	**1**
2,4-Dichlorophenol	120832	11	ug/L	[6]	0.2	NA	10	0.03	0.2
2,4-Dimethylphenol	105679	73	ug/L	[6]	1	NA	10	0.09	1
2,4-Dinitrophenol	51285	7.3	ug/L	[6]	5	NA	50	0.61	5
2,4-Dinitrotoluene	121142	0.11	ug/L	[1][3]	1	NA	10	0.05	**1**
2,6-Dinitrotoluene	606202	3.7	ug/L	[6]	1	NA	10	0.08	1
2-Chloronaphthalene	91587	290	ug/L	[6]	0.2	NA	10	0.02	0.2
2-Chlorophenol	95578	18	ug/L	[6]	1	NA	10	0.17	1
2-Methylnaphthalene	91576	15	ug/L	[6]	0.2	NA	10	0.01	0.2
2-Methylphenol	95487	13	ug/L	[11]	1	NA	10	0.09	1
2-Nitroaniline	88744	37	ug/L	[6]	5	NA	50	0.35	5
2-Nitrophenol	88755	1100	ug/L	[6]	1	NA	10	0.17	1
3,3',-Dichlorobenzidine	91941	0.021	ug/L	[1][3]	1	NA	20	**0.11**	**1**
3-Nitroaniline	99092	37	ug/L	[6]	5	NA	50	0.32	5
4,6-Dinitro-2-methylphenol	534521	0.29	ug/L	[6]	5	NA	50	0.22	**5**

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a] U	nits	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e,g]	
						MDLs	Method QLs	MDLs	QLs
4-Bromophenyl phenylether	101553	NA	ug/L	NA	1	NA	10	0.06	1
4-Chloro-3-methylphenol	59507	370	ug/L	[6]	1	NA	10	0.08	1
4-Chloroaniline	106478	0.34	ug/L	[6]	1	NA	20	0.09	**1**
4-Chlorophenyl phenylether	7005723	NA	ug/L	NA	1	NA	10	0.05	1
4-Methylphenol	106445	18	ug/L	[6]	1	NA	10	0.09	1
4-Nitroaniline	100016	3.4	ug/L	[6]	5	NA	50	0.02	**5**
4-Nitrophenol	100027	300	ug/L	[11]	5	NA	50	0.17	5
Acenaphthene	83329	220	ug/L	[6]	0.2	NA	10	0.01	0.2
Acenaphthylene	208968	220	ug/L	[6]	0.2	NA	10	0.02	0.2
Acetophenone	98862	370	ug/L	[6]	1	NA	10	0.08	1
Anthracene	120127	0.73	ug/L	[11]	0.2	NA	10	0.02	0.2
Atrazine	1912249	0.29	ug/L	[6]	1	NA	10	0.09	**1**
Benzaldehyde	100527	370	ug/L	[6]	1	NA	10	0.15	1
Benzo(g,h,i)perylene	191242	110	ug/L	[6]	0.2	NA	10	0.02	0.2
Benzo(a)pyrene	50328	0.0029	ug/L	[6]	0.2	NA	10	**0.01**	**0.2**
Benzo(a)anthracene	56553	0.0038	ug/L	[3]	0.2	NA	10	**0.01**	**0.2**
Benzo(b)fluoranthene	205992	0.0038	ug/L	[3]	0.2	NA	10	**0.02**	**0.2**
Benzo(k)fluoranthene	207089	0.0038	ug/L	[3]	0.2	NA	10	**0.05**	**0.2**
bis-(2-Chloroethoxy) methane	111911	11	ug/L	[6]	1	NA	10	0.06	1
bis-(2-Chloroethyl)ether	111444	0.012	ug/L	[6]	0.2	NA	10	**0.03**	**0.2**
2,2'-Oxybis (1-chloropropane)	108601	0.32	ug/L	[6]	0.2	NA	10	0.02	0.2
bis(2-Ethylhexyl)phthalate	117817	1.2	ug/L	[1][3]	0.2	NA	10	0.80	0.2
Butylbenzylphthalate	85687	19	ug/L	[11]	1	NA	10	0.14	1

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a] U	nits	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e,g]	
						MDLs	Method QLs	MDLs	QLs
Caprolactam	105602	1800	ug/L	[6]	1	NA	10	1.19	1
Carbazole	86748	NA	ug/L	NA	5	NA	10	0.02	5
Chrysene	218019	0.0038	ug/L	[3]	0.2	NA	10	**0.01**	**0.2**
Dibenzo(a,h)anthracene	53703	0.0029	ug/L	[6]	0.2	NA	10	**0.02**	**0.2**
Dibenzofuran	132649	3.7	ug/L	[6]	1	NA	10	0.06	1
Diethylphthalate	84662	210	ug/L	[11]	1	NA	10	0.15	1
Dimethylphthalate	131113	270000	ug/L	[3]	1	NA	10	0.08	1
Di-n-Butylphthalate	84742	35	ug/L	[11]	1	NA	10	0.13	1
Di-n-octylphthalate	117840	NA	ug/L	NA	1	NA	10	0.21	1
Fluoranthene	206440	130	ug/L	[1][3]	0.2	NA	10	0.02	0.2
Fluorene	86737	3.9	ug/L	[11]	0.2	NA	10	0.02	0.2
Hexachlorobenzene	118741	0.00028	ug/L	[1][3]	0.2	NA	10	**0.02**	**0.2**
Hexachlorobutadiene	87683	0.44	ug/L	[1][3]	0.2	NA	10	0.02	0.2
Hexchlorocyclopentadiene	77474	22	ug/L	[6]	1	NA	10	0.05	1
Hexachloroethane	67721	1.4	ug/L	[1][3]	1	NA	10	0.06	1
Indeno(1,2,3-cd)pyrene	193395	0.0038	ug/L	[3]	0.2	NA	10	**0.02**	**0.2**
Isophorone	78591	35	ug/L	[1][3]	1	NA	10	0.06	1
Naphthalene	91203	0.14	ug/L	[6]	0.2	NA	10	0.01	**0.2**
Nitrobenzene	98953	0.12	ug/L	[6]	0.2	NA	10	0.08	**0.2**
N-Nitrosodi-n-propylamine	621647	0.005	ug/L	[1][3]	0.2	NA	10	**0.03**	**0.2**
n-Nitrosodiphenylamine	86306	3.3	ug/L	[1][3]	0.2	NA	10	0.09	0.2
Pentachlorophenol	87865	0.17	ug/L	[6]	1	NA	50	0.07	**1**
Phenanthrene	85018	1100	ug/L	[6]	0.2	NA	10	0.04	0.2

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a] U	nits	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e,g]	
						MDLs	Method QLs	MDLs	QLs
Phenol	108952	1100	ug/L	[6]	0.2	NA	10	0.06	0.2
Pyrene	129000	110	ug/L	[6]	0.2	NA	10	0.06	0.2
Tentatively Identified Compounds	NA	NA	ug/L	NA	NA	NA	NA	NA	NA

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Matrix: Water
Analytical Group: PCB Congeners and Homologs
Concentration Level: Low

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	EDLs	QLs
PCB 1	2051-60-7	64	pg/L	[1][2][3][4]	40	NA	200	6.73	40
PCB 2	2051-61-8	64	pg/L	[1][2][3][4]	40	NA	10	4.18	40
PCB 3	2051-62-9	64	pg/L	[1][2][3][4]	40	NA	200	6.44	40
PCB 4	13029-08-8	64	pg/L	[1][2][3][4]	60	NA	500	10.40	60
PCB 5	16605-91-7	64	pg/L	[1][2][3][4]	40	NA	50	4.60	40
PCB 6	25569-80-6	64	pg/L	[1][2][3][4]	40	NA	50	6.62	40
PCB 7	33284-50-3	64	pg/L	[1][2][3][4]	40	NA	50	3.85	40
PCB 8	34883-43-7	64	pg/L	[1][2][3][4]	60	NA	500	8.61	60
PCB 9	34883-39-1	64	pg/L	[1][2][3][4]	40	NA	50	4.60	40
PCB 10	33146-45-1	64	pg/L	[1][2][3][4]	40	NA	50	7.35	40
PCB 11	2050-67-1	64	pg/L	[1][2][3][4]	60	NA	200	36.37	60
PCB 12	2974-92-7	64	pg/L	[1][2][3][4]	60	NA	100	20.40	60
PCB 13	2974-90-5	64	pg/L	[1][2][3][4]	60	NA	100	20.40	60
PCB 14	34883-41-5	64	pg/L	[1][2][3][4]	40	NA	100	5.78	40
PCB 15	2050-68-2	64	pg/L	[1][2][3][4]	40	NA	500	10.81	40
PCB 16	38444-78-9	64	pg/L	[1][2][3][4]	40	NA	100	8.57	40
PCB 17	37680-66-3	64	pg/L	[1][2][3][4]	40	NA	200	10.95	40
PCB 18	37680-65-2	64	pg/L	[1][2][3][4]	60	NA	500	11.45	60
PCB 19	38444-73-4	64	pg/L	[1][2][3][4]	40	NA	100	9.67	40
PCB 20	38444-84-7	64	pg/L	[1][2][3][4]	40	NA	500	16.62	40

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	EDLs	QLs
PCB 21	55702-46-0	64	pg/L	[1][2][3][4]	40	NA	200	12.64	40
PCB 22	38444-85-8	64	pg/L	[1][2][3][4]	40	NA	200	9.92	40
PCB 23	55720-44-0	64	pg/L	[1][2][3][4]	40	NA	200	3.16	40
PCB 24	55702-45-9	64	pg/L	[1][2][3][4]	40	NA	200	11.22	40
PCB 25	55712-37-3	64	pg/L	[1][2][3][4]	40	NA	200	7.67	40
PCB 26	38444-81-4	64	pg/L	[1][2][3][4]	40	NA	200	9.05	40
PCB 27	38444-76-7	64	pg/L	[1][2][3][4]	40	NA	200	5.63	40
PCB 28	7012-37-5	64	pg/L	[1][2][3][4]	40	NA	500	16.62	40
PCB 29	15862-07-4	64	pg/L	[1][2][3][4]	40	NA	200	9.05	40
PCB 30	35693-92-6	64	pg/L	[1][2][3][4]	60	NA	500	11.45	60
PCB 31	16606-02-3	64	pg/L	[1][2][3][4]	40	NA	500	10.12	40
PCB 32	38444-77-8	64	pg/L	[1][2][3][4]	40	NA	200	5.67	40
PCB 33	38444-86-9	64	pg/L	[1][2][3][4]	40	NA	200	12.64	40
PCB 34	37680-68-5	64	pg/L	[1][2][3][4]	40	NA	200	3.38	40
PCB 35	37680-69-6	64	pg/L	[1][2][3][4]	40	NA	200	9.58	40
PCB 36	38444-87-0	64	pg/L	[1][2][3][4]	40	NA	200	7.49	40
PCB 37	38444-90-5	64	pg/L	[1][2][3][4]	40	NA	500	8.96	40
PCB 38	53555-66-1	64	pg/L	[1][2][3][4]	40	NA	200	4.65	40
PCB 39	38444-88-1	64	pg/L	[1][2][3][4]	40	NA	200	7.33	40
PCB 40	38444-93-8	64	pg/L	[1][2][3][4]	40	NA	500	6.45	40
PCB 41	52663-59-9	64	pg/L	[1][2][3][4]	40	NA	500	6.45	40
PCB 42	36559-22-5	64	pg/L	[1][2][3][4]	40	NA	200	4.04	40
PCB 43	70362-46-8	64	pg/L	[1][2][3][4]	40	NA	200	9.35	40

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	EDLs	QLs
PCB 44	41464-39-5	64	pg/L	[1][2][3][4]	40	NA	500	10.67	40
PCB 45	70362-45-7	64	pg/L	[1][2][3][4]	40	NA	200	12.06	40
PCB 46	41464-47-5	64	pg/L	[1][2][3][4]	40	NA	200	2.62	40
PCB 47	2437-79-8	64	pg/L	[1][2][3][4]	40	NA	500	10.67	40
PCB 48	70362-47-9	64	pg/L	[1][2][3][4]	40	NA	200	2.55	40
PCB 49	41464-40-8	64	pg/L	[1][2][3][4]	40	NA	500	8.53	40
PCB 50	62796-65-0	64	pg/L	[1][2][3][4]	40	NA	200	9.16	40
PCB 51	68194-04-7	64	pg/L	[1][2][3][4]	40	NA	200	12.06	40
PCB 52	35693-99-3	64	pg/L	[1][2][3][4]	40	NA	500	7.50	40
PBB 53	41464419	64	pg/L	[1][2][3][4]	40	NA	500	9.16	40
PCB 54	15968-05-5	64	pg/L	[1][2][3][4]	40	NA	500	4.69	40
PCB 55	74338-24-2	64	pg/L	[1][2][3][4]	40	NA	500	6.13	40
PCB 56	41464-43-1	64	pg/L	[1][2][3][4]	40	NA	200	4.97	40
PCB 57	70424-67-8	64	pg/L	[1][2][3][4]	40	NA	500	4.62	40
PCB 58	41464-49-7	64	pg/L	[1][2][3][4]	40	NA	500	2.76	40
PCB 59	74472-33-6	64	pg/L	[1][2][3][4]	40	NA	200	11.65	40
PCB 60	33025-41-1	64	pg/L	[1][2][3][4]	40	NA	500	4.84	40
PCB 61	33284-53-6	64	pg/L	[1][2][3][4]	40	NA	500	23.80	40
PCB 62	54230-22-7	64	pg/L	[1][2][3][4]	40	NA	200	11.65	40
PCB 63	74472-34-7	64	pg/L	[1][2][3][4]	40	NA	500	4.77	40
PCB 64	52663-58-8	64	pg/L	[1][2][3][4]	40	NA	200	4.99	40
PCB 65	33284-54-7	64	pg/L	[1][2][3][4]	40	NA	500	10.67	40
PCB 66	32598-10-0	64	pg/L	[1][2][3][4]	40	NA	500	12.05	40

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	EDLs	QLs
PCB 67	73575-53-8	64	pg/L	[1][2][3][4]	40	NA	500	5.69	40
PCB 68	73575-52-7	64	pg/L	[1][2][3][4]	40	NA	500	3.86	40
PCB 69	60233-24-1	64	pg/L	[1][2][3][4]	40	NA	500	8.53	40
PCB 70	32598-11-1	64	pg/L	[1][2][3][4]	40	NA	500	23.80	40
PCB 71	41464-46-4	64	pg/L	[1][2][3][4]	40	NA	500	6.45	40
PCB 72	41464-42-0	64	pg/L	[1][2][3][4]	40	NA	500	3.67	40
PCB 73	74338-23-1	64	pg/L	[1][2][3][4]	40	NA	500	9.35	40
PCB 74	32690-93-0	64	pg/L	[1][2][3][4]	40	NA	500	23.80	40
PCB 75	32598-12-2	64	pg/L	[1][2][3][4]	40	NA	500	11.65	40
PCB 76	70362-48-0	64	pg/L	[1][2][3][4]	40	NA	500	23.80	40
PCB 77	32598-13-3	50	pg/L	[1][3]	40	NA	500	4.36	40
PCB 78	70362-49-1	64	pg/L	[1][2][3][4]	40	NA	500	4.43	40
PCB 79	41464-48-6	64	pg/L	[1][2][3][4]	40	NA	500	3.15	40
PCB 80	33284-52-5	64	pg/L	[1][2][3][4]	40	NA	500	3.59	40
PCB 81	70362-50-4	17	pg/L	[1][3]	40	NA	500	3.41	**40**
PCB 82	52663-62-4	64	pg/L	[1][2][3][4]	40	NA	500	8.29	40
PCB 83	60145-20-2	64	pg/L	[1][2][3][4]	40	NA	500	9.28	40
PCB 84	52663-60-2	64	pg/L	[1][2][3][4]	40	NA	500	5.97	40
PCB 85	65510-45-4	64	pg/L	[1][2][3][4]	40	NA	500	8.37	40
PCB 86	55312-69-1	64	pg/L	[1][2][3][4]	40	NA	500	10.46	40
PCB 87	38380-02-8	64	pg/L	[1][2][3][4]	40	NA	500	10.46	40
PCB 88	55215-17-3	64	pg/L	[1][2][3][4]	40	NA	500	7.37	40
PCB 89	73575-57-2	64	pg/L	[1][2][3][4]	40	NA	500	5.57	40

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	EDLs	QLs
PCB 90	68194-07-0	64	pg/L	[1][2][3][4]	40	NA	500	4.70	40
PCB 91	68194-05-8	64	pg/L	[1][2][3][4]	40	NA	500	7.37	40
PCB 92	52663-61-3	64	pg/L	[1][2][3][4]	40	NA	500	3.67	40
PCB 93	73575-56-1	64	pg/L	[1][2][3][4]	40	NA	500	7.55	40
PCB 94	73575-55-0	64	pg/L	[1][2][3][4]	40	NA	500	4.51	40
PCB 95	38379-99-6	64	pg/L	[1][2][3][4]	40	NA	500	6.75	40
PCB 96	73575-54-9	64	pg/L	[1][2][3][4]	40	NA	500	2.64	40
PCB 97	41464-51-1	64	pg/L	[1][2][3][4]	40	NA	500	10.46	40
PCB 98	60233-25-2	64	pg/L	[1][2][3][4]	40	NA	500	12.09	40
PCB 99	38380-01-7	64	pg/L	[1][2][3][4]	40	NA	500	17.70	40
PCB 100	39485-83-1	64	pg/L	[1][2][3][4]	40	NA	500	7.55	40
PCB 101	37680-73-2	64	pg/L	[1][2][3][4]	40	NA	1000	4.70	40
PCB 102	68194-06-9	64	pg/L	[1][2][3][4]	40	NA	500	12.09	40
PCB 103	60145-21-3	64	pg/L	[1][2][3][4]	40	NA	500	2.52	40
PCB 104	56558-16-8	64	pg/L	[1][2][3][4]	40	NA	500	5.75	40
PCB 105	32598-14-4	167	pg/L	[1][3]	40	NA	200	4.45	40
PCB 106	70424-69-0	64	pg/L	[1][2][3][4]	40	NA	500	5.80	40
PCB 107	70424-68-9	64	pg/L	[1][2][3][4]	40	NA	200	3.72	40
PCB 108	70362-41-3	64	pg/L	[1][2][3][4]	40	NA	1000	22.86	40
PCB 109	74472-35-8	64	pg/L	[1][2][3][4]	40	NA	500	10.46	40
PCB 110	38380-03-9	64	pg/L	[1][2][3][4]	40	NA	1000	7.25	40
PCB 111	39635-32-0	64	pg/L	[1][2][3][4]	40	NA	1000	3.43	40
PCB 112	74472-36-9	64	pg/L	[1][2][3][4]	40	NA	1000	17.70	40

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	EDLs	QLs
PCB 113	68194-10-5	64	pg/L	[1][2][3][4]	40	NA	1000	4.70	40
PCB 114	74472-37-0	167	pg/L	[1][3]	40	NA	500	4.67	40
PCB 115	74472-38-1	64	pg/L	[1][2][3][4]	40	NA	1000	7.25	40
PCB 116	18259-05-7	64	pg/L	[1][2][3][4]	40	NA	200	8.37	40
PCB 117	68194-11-6	64	pg/L	[1][2][3][4]	40	NA	200	8.37	40
PCB 118	31508-00-6	167	pg/L	[1][3]	40	NA	500	6.27	40
PCB 119	56558-17-9	64	pg/L	[1][2][3][4]	40	NA	500	10.46	40
PCB 120	68194-12-7	64	pg/L	[1][2][3][4]	40	NA	500	3.45	40
PCB 121	56558-18-0	64	pg/L	[1][2][3][4]	40	NA	500	3.45	40
PCB 122	76842-07-4	64	pg/L	[1][2][3][4]	40	NA	500	4.58	40
PCB 123	65510-44-3	167	pg/L	[1][3]	40	NA	500	5.04	40
PCB 124	70424-70-3	64	pg/L	[1][2][3][4]	40	NA	1000	22.86	40
PCB 125	74472-39-2	64	pg/L	[1][2][3][4]	40	NA	500	10.46	40
PCB 126	57465-28-8	0.05	pg/L	[1][3]	40	NA	500	**2.16**	**40**
PCB 127	39635-33-1	64	pg/L	[1][2][3][4]	40	NA	1000	6.56	40
PCB 128	38380-07-3	64	pg/L	[1][2][3][4]	40	NA	500	10.78	40
PCB 129	55215-18-4	64	pg/L	[1][2][3][4]	40	NA	500	8.91	40
PCB 130	52663-66-8	64	pg/L	[1][2][3][4]	40	NA	500	8.69	40
PCB 131	61798-70-7	64	pg/L	[1][2][3][4]	40	NA	500	1.27	40
PCB 132	38380-05-1	64	pg/L	[1][2][3][4]	40	NA	500	4.62	40
PCB 133	35694-04-3	64	pg/L	[1][2][3][4]	40	NA	500	2.67	40
PCB 134	52704-70-8	64	pg/L	[1][2][3][4]	40	NA	500	10.43	40
PCB 135	52744-13-5	64	pg/L	[1][2][3][4]	40	NA	500	6.28	40

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	EDLs	QLs
PCB 136	38411-22-2	64	pg/L	[1][2][3][4]	40	NA	200	3.36	40
PCB 137	35694-06-5	64	pg/L	[1][2][3][4]	40	NA	1000	3.50	40
PCB 138	35065-28-2	64	pg/L	[1][2][3][4]	40	NA	500	8.91	40
PCB 139	56030-56-9	64	pg/L	[1][2][3][4]	40	NA	500	4.37	40
PCB 140	59291-64-4	64	pg/L	[1][2][3][4]	40	NA	500	4.37	40
PCB 141	52712-04-6	64	pg/L	[1][2][3][4]	40	NA	200	3.77	40
PCB 142	41411-61-4	64	pg/L	[1][2][3][4]	40	NA	1000	4.40	40
PCB 143	68194-15-0	64	pg/L	[1][2][3][4]	40	NA	500	10.43	40
PCB 144	68194-14-9	64	pg/L	[1][2][3][4]	40	NA	500	5.50	40
PCB 145	74472-40-5	64	pg/L	[1][2][3][4]	40	NA	1000	3.12	40
PCB 146	51908-16-8	64	pg/L	[1][2][3][4]	40	NA	500	4.91	40
PCB 147	68194-13-8	64	pg/L	[1][2][3][4]	40	NA	500	4.52	40
PCB 148	74472-41-6	64	pg/L	[1][2][3][4]	40	NA	1000	5.00	40
PCB 149	38380-04-0	64	pg/L	[1][2][3][4]	40	NA	1000	4.52	40
PCB 150	68194-08-1	64	pg/L	[1][2][3][4]	40	NA	1000	3.41	40
PCB 151	52663-63-5	64	pg/L	[1][2][3][4]	40	NA	500	6.28	40
PCB 152	68194-09-2	64	pg/L	[1][2][3][4]	40	NA	1000	2.30	40
PCB 153	35065-27-1	64	pg/L	[1][2][3][4]	40	NA	500	7.11	40
PCB 154	60145-22-4	64	pg/L	[1][2][3][4]	40	NA	500	4.88	40
PCB 155	33979-03-2	64	pg/L	[1][2][3][4]	40	NA	1000	3.16	40
PCB 156	38380-08-4	167	pg/L	[1][3]	40	NA	500	4.48	40
PCB 157	69782-90-7	167	pg/L	[1][3]	40	NA	500	4.48	40
PCB 158	74472-42-7	64	pg/L	[1][2][3][4]	40	NA	200	2.46	40

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	EDLs	QLs
PCB 159	39635-35-3	64	pg/L	[1][2][3][4]	40	NA	1000	3.38	40
PCB 160	41411-62-5	64	pg/L	[1][2][3][4]	40	NA	500	7.22	40
PCB 161	74472-43-8	64	pg/L	[1][2][3][4]	40	NA	1000	2.62	40
PCB 162	39635-34-2	64	pg/L	[1][2][3][4]	40	NA	1000	4.07	40
PCB 163	74472-44-9	64	pg/L	[1][2][3][4]	40	NA	500	8.91	40
PCB 164	74472-45-0	64	pg/L	[1][2][3][4]	40	NA	500	3.50	40
PCB 165	74472-46-1	64	pg/L	[1][2][3][4]	40	NA	1000	4.06	40
PCB 166	41411-63-6	64	pg/L	[1][2][3][4]	40	NA	500	10.78	40
PCB 167	52663-72-6	167	pg/L	[1][3]	40	NA	500	4.96	40
PCB 168	59291-65-5	64	pg/L	[1][2][3][4]	40	NA	500	7.11	40
PCB 169	32774-16-6	0.167	pg/L	[1][3]	40	NA	500	**3.63**	**40**
PCB 170	35065-30-6	64	pg/L	[1][2][3][4]	40	NA	500	2.91	40
PCB 171	52663-71-5	64	pg/L	[1][2][3][4]	40	NA	1000	7.80	40
PCB 172	52663-74-8	64	pg/L	[1][2][3][4]	40	NA	1000	3.37	40
PCB 173	68194-16-1	64	pg/L	[1][2][3][4]	40	NA	1000	7.80	40
PCB 174	38411-25-5	64	pg/L	[1][2][3][4]	40	NA	500	6.46	40
PCB 175	40186-70-7	64	pg/L	[1][2][3][4]	40	NA	1000	5.63	40
PCB 176	52663-65-7	64	pg/L	[1][2][3][4]	40	NA	1000	2.20	40
PCB 177	52663-70-4	64	pg/L	[1][2][3][4]	40	NA	500	2.24	40
PCB 178	52663-67-9	64	pg/L	[1][2][3][4]	40	NA	500	2.88	40
PCB 179	52663-64-6	64	pg/L	[1][2][3][4]	40	NA	500	2.47	40
PCB 180	35065-29-3	64	pg/L	[1][2][3][4]	40	NA	500	7.77	40
PCB 181	74472-47-2	64	pg/L	[1][2][3][4]	40	NA	1000	5.44	40

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	EDLs	QLs
PCB 182	60145-23-5	64	pg/L	[1][2][3][4]	40	NA	1000	3.59	40
PCB 183	52663-69-1	64	pg/L	[1][2][3][4]	40	NA	1000	4.27	40
PCB 184	74472-48-3	64	pg/L	[1][2][3][4]	40	NA	1000	3.31	40
PCB 185	52712-05-7	64	pg/L	[1][2][3][4]	40	NA	1000	4.27	40
PCB 186	74472-49-4	64	pg/L	[1][2][3][4]	40	NA	1000	4.18	40
PCB 187	52663-68-0	64	pg/L	[1][2][3][4]	40	NA	500	4.50	40
PCB 188	74487-85-7	64	pg/L	[1][2][3][4]	40	NA	500	4.32	40
PCB 189	39635-31-9	167	pg/L	[1][3]	40	NA	500	2.80	40
PCB 190	41411-64-7	64	pg/L	[1][2][3][4]	40	NA	500	2.46	40
PCB 191	74472-50-7	64	pg/L	[1][2][3][4]	40	NA	1000	3.13	40
PCB 192	74472-51-8	64	pg/L	[1][2][3][4]	40	NA	1000	3.67	40
PCB 193	69782-91-8	64	pg/L	[1][2][3][4]	40	NA	500	7.77	40
PCB 194	35694-08-7	64	pg/L	[1][2][3][4]	40	NA	500	4.98	40
PCB 195	52663-78-2	64	pg/L	[1][2][3][4]	40	NA	1000	6.21	40
PCB 196	42740-50-1	64	pg/L	[1][2][3][4]	40	NA	1000	6.18	40
PCB 197	33091-17-7	64	pg/L	[1][2][3][4]	40	NA	1000	5.59	40
PCB 198	68194-17-2	64	pg/L	[1][2][3][4]	40	NA	500	12.97	40
PCB 199	52663-75-9	64	pg/L	[1][2][3][4]	40	NA	500	12.97	40
PCB 200	52663-73-7	64	pg/L	[1][2][3][4]	40	NA	1000	5.59	40
PCB 201	40186-71-8	64	pg/L	[1][2][3][4]	40	NA	1000	4.29	40
PCB 202	2136-99-4	64	pg/L	[1][2][3][4]	40	NA	1000	3.91	40
PCB 203	52663-76-0	64	pg/L	[1][2][3][4]	40	NA	1000	4.91	40
PCB 204	74472-52-9	64	pg/L	[1][2][3][4]	40	NA	1000	3.06	40

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	EDLs	QLs
PCB 205	74472-53-0	64	pg/L	[1][2][3][4]	40	NA	1000	5.50	40
PCB 206	40186-72-9	64	pg/L	[1][2][3][4]	40	NA	1000	3.17	40
PCB 207	52663-79-3	64	pg/L	[1][2][3][4]	40	NA	1000	2.68	40
PCB 208	52663-77-1	64	pg/L	[1][2][3][4]	40	NA	1000	3.49	40
PCB 209	2051-24-3	64	pg/L	[1][2][3][4]	40	NA	500	2.47	40
Monochlorobiphenyl	27323-18-8	64	pg/L	[1][2][3][4]	NA	NA	NA	NA	NA
Dichlorobiphenyl	25512-42-9	64	pg/L	[1][2][3][4]	NA	NA	NA	NA	NA
Trichlorobiphenyl	25323-68-6	64	pg/L	[1][2][3][4]	NA	NA	NA	NA	NA
Tetrachlorobiphenyl	26914-33-0	64	pg/L	[1][2][3][4]	NA	NA	NA	NA	NA
Pentachlorobiphenyl	25429-29-2	64	pg/L	[1][2][3][4]	NA	NA	NA	NA	NA
Hexachlorobiphenyl	26601-64-9	64	pg/L	[1][2][3][4]	NA	NA	NA	NA	NA
Heptachlorobiphenyl	28655-71-2	64	pg/L	[1][2][3][4]	NA	NA	NA	NA	NA
Octachlorobiphenyl	55722-26-4	64	pg/L	[1][2][3][4]	NA	NA	NA	NA	NA
Nonachlorobiphenyl	53742-07-7	64	pg/L	[1][2][3][4]	NA	NA	NA	NA	NA

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Matrix: Water
Analytical Group: TAL Metals + Titanium, Hexavalent Chromium, and Methyl Mercury
Concentration Level: Low

Analyte	CAS Number	Laboratory SOP[f]	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
							MDLs	Method QLs	MDLs	QLs
Aluminum	7429905	C-3, C-4	50	ug/L	[5]	2	NA	NA	0.3	2
Antimony	7440360	C-3, C-5	1.5	ug/L	[6]	0.05	NA	NA	0.02	0.05
Arsenic	7440382	C-5, C-6	0.017	ug/L	[1]	0.5	NA	NA	**0.1**	**0.5**
Arsenic	7440382	C-3, C-5	0.017	ug/L	[1]	0.5	NA	NA	**0.03**	**0.5**
Barium	7440393	C-3, C-5	4	ug/L	[11]	0.05	NA	NA	0.02	0.05
Beryllium	7440417	C-3, C-5	0.66	ug/L	[11]	0.02	NA	NA	0.006	0.02
Beryllium	7440417	C-5, C-6	0.66	ug/L	[11]	0.02	NA	NA	0.0007	0.02
Cadmium	7440439	C-3, C-5	0.18	ug/L	[7]	0.02	NA	NA	0.005	0.02
Cadmium	7440439	C-5, C-6	0.18	ug/L	[7]	0.02	NA	NA	0.001	0.02
Calcium	7440702	C-3, C-4	NA	ug/L	NA	4	NA	NA	2	4
Chromium	7440473	C-3, C-5	0.043	ug/L	[6]	0.2	NA	NA	0.04	**0.2**
Chromium	7440473	C-5, C-6	0.043	ug/L	[6]	0.2	NA	NA	0.02	**0.2**
Chromium (VI)	18540299	C-15	0.043	ug/L	[6]	10	NA	NA	0.01	0.02
Cobalt	7440484	C-3, C-5	1.1	ug/L	[6]	0.02	NA	NA	0.006	0.02
Cobalt	7440484	C-5, C-6	1.1	ug/L	[6]	0.02	NA	NA	0.002	0.02
Copper	7440508	C-3, C-5	3.1	ug/L	[10]	0.1	NA	NA	0.02	0.1
Copper	7440508	C-5, C-6	3.1	ug/L	[10]	0.1	NA	NA	0.03	0.1
Iron	7439896	C-3, C-4	300	ug/L	[3][5]	10	NA	NA	3	10
Lead	7439921	C-3, C-5	2.5	ug/L	[9]	0.02	NA	NA	0.005	0.02
Lead	7439921	C-5, C-6	2.5	ug/L	[9]	0.02	NA	NA	0.008	0.04

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	Laboratory SOP[f]	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
							MDLs	Method QLs	MDLs	QLs
Magnesium	7439954	C-3, C-4	NA	ug/L	NA	2	NA	NA	0.4	2
Manganese	7439965	C-3, C-5	50	ug/L	[3][5]	0.05	NA	NA	0.006	0.05
Mercury	7439976	B-1	50	ng/L	[1]	1	NA	NA	0.15	0.4
Methyl mercury	22967926	B-2	2.8	ng/L	[11]	0.05	NA	0.02	0.02	0.05
Nickel	7440020	C-3, C-5	8.2	ug/L	[10]	0.2	NA	NA	0.03	0.2
Nickel	7440020	C-5, C-6	8.2	ug/L	[10]	0.2	NA	NA	0.04	0.2
Potassium	7440097	C-3, C-4	NA	ug/L	NA	100	NA	NA	50	100
Silver	7440224	C-3, C-5	0.36	ug/L	[11]	0.02	NA	NA	0.004	0.02
Silver	7440224	C-5, C-6	0.36	ug/L	[11]	0.02	NA	NA	0.002	0.02
Selenium	7782492	C-3, C-5	5	ug/L	[7][9]	1	NA	NA	0.3	1
Sodium	7440235	C-3, C-4	NA	ug/L	NA	200	NA	NA	70	200
Thallium	7440280	C-3, C-5	0.037	ug/L	[6]	0.02	NA	NA	0.005	0.02
Thallium	7440280	C-5, C-6	0.037	ug/L	[6]	0.02	NA	NA	0.004	0.02
Titanium	7440326	C-3, C-4	0.00015	ug/L	[6]	1	NA	NA	**0.04**	**1**
Vanadium	7440622	C-3, C-5	18	ug/L	[6]	0.2	NA	NA	0.03	0.2
Zinc	7440666	C-3, C-5	81	ug/L	[8][10]	0.5	NA	NA	0.2	0.5
Zinc	7440666	C-5, C-6	81	ug/L	[8][10]	0.5	NA	NA	0.05	0.5

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Matrix: Water
Analytical Group: PCDD/PCDFs
Concentration Level: Low

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c] MDLs	Analytical Method[c] Method QLs	Achievable Laboratory Limits[d,e] MDLs	Achievable Laboratory Limits[d,e] QLs
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	39001-02-0	17	pg/L	[1][3]	50	NA	50	6.5	**50**
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	3268-87-9	17	pg/L	[1][3]	50	NA	50	7.5	**50**
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	67562-39-4	0.5	pg/L	[1][3]	25	NA	50	**1.3**	**25**
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	35822-46-9	0.5	pg/L	[1][3]	25	NA	50	**3.1**	**25**
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	55673-89-7	0.5	pg/L	[1][3]	25	NA	50	**2**	**25**
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	70648-26-9	0.05	pg/L	[1][3]	25	NA	50	**2.1**	**25**
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	39227-28-6	0.05	pg/L	[1][3]	25	NA	50	**2.1**	**25**
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	57117-44-9	0.05	pg/L	[1][3]	25	NA	50	**0.96**	**25**
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	57653-85-7	0.05	pg/L	[1][3]	25	NA	50	**2.2**	**25**
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	72918-21-9	0.05	pg/L	[1][3]	25	NA	50	**1.6**	**25**
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	19408-74-3	0.05	pg/L	[1][3]	25	NA	50	**2.5**	**25**
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	57117-41-6	0.17	pg/L	[1][3]	25	NA	50	**1.8**	**25**
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	40321-76-4	0.005	pg/L	[1][3]	25	NA	50	**1.9**	**25**
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	60851-34-5	0.05	pg/L	[1][3]	25	NA	50	**1**	**25**
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	57117-31-4	0.017	pg/L	[1][3]	25	NA	50	**1.6**	**25**
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	51207-31-9	0.05	pg/L	[1][3]	5	NA	10	**1.2**	**5**
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	0.005	pg/L	[1][3]	5	NA	10	**1.2**	**5**
Total HpCDF	38998-75-3	NA	pg/L	NA	50	NA	NA	NA	50
Total HpCDD	37871-00-4	NA	pg/L	NA	50	NA	NA	NA	50

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	EDLs	QLs
Total HxCDF	55684-94-1	NA	pg/L	NA	50	NA	NA	NA	50
Total HxCDD	34465-46-8	NA	pg/L	NA	50	NA	NA	NA	50
Total PeCDF	30402-15-4	NA	pg/L	NA	50	NA	NA	NA	50
Total PeCDD	36088-22-9	NA	pg/L	NA	50	NA	NA	NA	50
Total TCDF	55722-27-5	NA	pg/L	NA	50	NA	NA	NA	50
Total TCDD	41903-57-5	NA	pg/L	NA	50	NA	NA	NA	50

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Matrix: Water
Analytical Group: General Chemistry
Concentration Level: Low

Analyte	CAS Number	Laboratory SOP[f]	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
							MDLs	Method QLs	MDLs	QLs
Total Organic Carbon (TOC)	NA	C-13	NA	ug/L	NA	300	NA	NA	30	300
Dissolved Organic Carbon (DOC)	NA	C-13	NA	ug/L	NA	300	NA	NA	100	300
Particulate Organic Carbon (POC)	NA	C-16	NA	mg/kg	NA	1300	NA	NA	500	1300
Suspended Sediment Concentrations	NA	C-17	NA	ug/L	NA	NA	NA	NA	1000	NA
Total Dissolved Solids	NA	C-19	NA	ug/L	NA	5000	NA	NA	5000	5000
Hardness	NA	C-18	NA	ug/L	NA	1000	NA	NA	NA	1000
Alkalinity	NA	C-20	NA	ug/L	NA	2	NA	NA	1	2
Ammonia	7664-41-7	C-9	50	ug/L	[8]	0.05	NA	NA	0.02	0.05
Total Kjeldahl Nitrogen	7727-37-9	C-12	NA	ug/L	NA	0.2	NA	NA	0.08	0.2
Total Phosphorus	14365-44-2	C-11	NA	ug/L	NA	0.01	NA	NA	0.004	0.01
Total Sulfide	18496-25-8	C-14	NA	ug/L	NA	2	NA	NA	0.3	2
Sulfate	14808-79-8	C-21	NA	ug/L	NA	0.2	NA	NA	0.01	0.2
Chloride	NA	C-21	NA	ug/L	NA	0.2	NA	NA	0.03	0.2
Chlorophyll a	42617163	C-22	NA	mg/m^3	NA	0.8	NA	NA	0.3	0.8
Cyanide	57-12-5	C-10	1	ug/L	[8][10]	0.01	NA	NA	0.003	0.01

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Matrix: Water
Analytical Group: PAHs and alkyl PAHs by LRMS-SIM isotope dilution
Concentration Level: Low

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e,g]	
						MDLs	Method QLs	MDLs	QLs
1-Methylnaphthalene	90120	2100	ng/L	[11]	10	NA	NA	4.1	10
1-Methylphenanthrene	832699	1100000	ng/L	[6]	10	NA	NA	0.7	10
2,3,5-Trimethylnaphthalene	2245387	140	ng/L	[6]	10	NA	NA	1.6	10
2,6-Dimethylnaphthalene	581420	140	ng/L	[6]	10	NA	NA	2.2	10
2-Methylnaphthalene	91576	15000	ng/L	[6]	20	NA	NA	8.3	20
Acenaphthene	83329	220000	ng/L	[6]	10	NA	NA	2.4	10
Acenaphthylene	208968	220000	ng/L	[6]	10	NA	NA	0.15	10
Anthracene	120127	730	ng/L	[11]	10	NA	NA	0.71	10
Fluorene	86737	3900	ng/L	[11]	10	NA	NA	1.5	10
Naphthalene	91203	140	ng/L	[6]	50	NA	NA	16	50
Phenanthrene	85018	1100000	ng/L	[6]	20	NA	NA	11	20
Benzo[a]anthracene	56553	3.8	ng/L	[3]	10	NA	NA	1.5	**10**
Benzo[a]pyrene	50328	2.9	ng/L	[6]	10	NA	NA	0.4	**10**
Benzo[b]fluoranthene	205992	3.8	ng/L	[3]	10	NA	NA	1.5	**10**
Benzo[e]pyrene	192972	200	ng/L	[5]	10	NA	NA	1.4	10
Benzo[g,h,i]perylene	191242	110000	ng/L	[6]	10	NA	NA	0.51	10
Benzo[k]fluoranthene	207089	3.8	ng/L	[3]	10	NA	NA	1	**10**
Chrysene	218019	3.8	ng/L	[3]	10	NA	NA	0.22	**10**
Dibenzo[a,h]anthracene	53703	2.9	ng/L	[6]	10	NA	NA	0.78	**10**
Dibenzothiophene	132650	NA	ng/L	NA	10	NA	NA	0.69	10

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e,g]	
						MDLs	Method QLs	MDLs	QLs
Fluoranthene	206440	130000	ng/L	[1][3]	10	NA	NA	2.4	10
Indeno(1,2,3-cd)pyrene	193395	3.8	ng/L	[3]	10	NA	NA	1	**10**
Perylene	198550	110000	ng/L	[6]	10	NA	NA	0.81	10
Pyrene	129000	110000	ng/L	[6]	10	NA	NA	1.7	10
C1-Benzanthracene/chrysenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C1-Dibenzothiophenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C1-Fluorenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C1-Naphthalenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C1-Phenanthrene/anthracenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C1-Pyrene/fluoranthenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C2-Benzanthracene/chrysenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C2-Dibenzothiophenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C2-Fluorenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C2-Naphthalenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C2-Phenanthrene/anthracenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C3-Benzanthracene/chrysenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C3-Dibenzothiophenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C3-Fluorenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C3-Naphthalenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C3-Phenanthrene/anthracenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C4-Benzanthracene/chrysenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C4-Dibenzothiophenes	NA	NA	ng/L	NA	10	NA	NA	10	10

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e,g]	
						MDLs	Method QLs	MDLs	QLs
C4-Naphthalenes	NA	NA	ng/L	NA	10	NA	NA	10	10
C4-Phenanthrenes/anthracenes	NA	NA	ng/L	NA	10	NA	NA	10	10

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Matrix: Water
Analytical Group: OC Pesticides
Concentration Level: Low

Analyte	CAS Number	PAL[a] U	nits	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	EDLs	QLs
alpha-BHC	319846	2.6	ng/L	[1][3]	0.4	NA	0.06	0.012	0.4
beta-BHC	319857	9.1	ng/L	[1][3]	0.4	NA	0.06	0.015	0.4
delta-BHC	319868	2.6	ng/L	[1][3]	0.4	NA	0.06	0.018	0.4
gamma-BHC (Lindane)	58899	61	ng/L	[6]	0.4	NA	0.06	0.016	0.4
Heptachlor	76448	0.079	ng/L	[1][2][3][4]	0.4	NA	0.03	0.011	**0.4**
Aldrin	309002	0.049	ng/L	[1][3]	0.4	NA	0.09	0.036	**0.4**
Heptachlor epoxide	1024573	0.039	ng/L	[1][2][3][4]	0.4	NA	0.04	0.013	**0.4**
Endosulfan I	959988	8.7	ng/L	[8][10]	0.4	NA	0.1	0.066	2.0
Dieldrin	60571	0.052	ng/L	[1][3]	0.4	NA	0.03	0.021	**0.4**
4,4'-DDE	72559	0.22	ng/L	[1][2][3][4]	0.4	NA	0.03	0.080	**0.4**
2,4'-DDE	3424826	0.22	ng/L	[1][2][3][4]	0.4	NA	0.03	0.062	**0.4**
Endrin	72208	2.3	ng/L	[8][10]	0.4	NA	0.03	0.157	0.4
Endosulfan II	33213659	8.7	ng/L	[8][10]	0.4	NA	0.1	0.093	0.4
4,4'-DDD	72548	0.31	ng/L	[1][2][3][4]	0.4	NA	0.03	0.030	**0.4**
2,4'-DDD	53190	0.31	ng/L	[1][2][3][4]	0.4	NA	0.03	0.029	**0.4**
Endosulfan sulfate	1031078	8.7	ng/L	[8][10]	0.4	NA	0.04	0.010	0.4
4,4'-DDT	50293	0.22	ng/L	[1][2][3][4]	0.4	NA	0.03	0.044	**0.4**
2,4'-DDT	789026	0.22	ng/L	[1][2][3][4]	0.4	NA	0.03	0.039	**0.4**
Methoxychlor	72435	19	ng/L	[11]	0.4	NA	0.03	0.012	0.4
Endrin ketone	53494705	2.3	ng/L	[8][10]	0.4	NA	0.04	0.022	0.4

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Analyte	CAS Number	PAL[a] U	nits	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	EDLs	QLs
Endrin aldehyde	7421934	2.3	ng/L	[8][10]	0.4	NA	0.04	0.037	0.4
cis-Chlordane	5103719	0.1	ng/L	[1]	0.4	NA	0.03	0.021	**0.4**
trans-Chlordane	5103742	0.1	ng/L	[1]	0.4	NA	0.05	0.023	**0.4**
Oxychlordane	27304138	0.1	ng/L	[1]	0.4	NA	0.06	0.029	**0.4**
cis-Nonachlor	5103731	0.1	ng/L	[1][3]	0.4	NA	0.03	0.029	**0.4**
trans-Nonachlor	3734494	0.1	ng/L	[1]	0.4	NA	0.04	0.024	**0.4**
Hexachlorobenzene	118741	0.28	ng/L	[1][3]	0.4	NA	0.04	0.003	**0.4**

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Matrix: Water
Analytical Group: Butyltins
Concentration Level: Low

Analyte	CAS Number	PAL[a] U	nits	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	MDLs	QLs
Monobutyltin	78763-54-9	1100	ng/L	[6]	50	NA	NA	29	50
Dibutyltin	14488-53-0	1100	ng/L	[6]	50	NA	NA	7.3	50
Tributyltin	36643-28-4	1100	ng/L	[6]	50	NA	NA	38	50
Tetrabutyltin	1461-25-2	1100	ng/L	[6]	50	NA	NA	12	50

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

Matrix: Water
Analytical Group: Bacteria and Protozoa
Concentration Level: Low

Analyte	CAS Number	PAL[a]	Units	PAL Source[a]	Project QL[b] (ug/L)	Analytical Method[c]		Achievable Laboratory Limits[d,e]	
						MDLs	Method QLs	MDLs	QLs
Total coliform bacteria	NA	NA	CFU/ 100mL	NA	1	NA	1	NA	1
E. coli	NA	NA	CFU/ 100mL	NA	1	NA	1	NA	1
Fecal coliform bacteria	NA	NA	CFU/ 100mL	NA	1	NA	1	NA	1
Fecal streptococci bacteria	NA	NA	CFU/ 100mL	NA	1	NA	1	NA	1
Fecal enterococci bacteria	NA	NA	CFU/ 100mL	NA	1	NA	1	NA	1
Cryptosporidium	137259-50-8	NA	Oocysts/L	NA	1	NA	1	NA	1
Giardia	137259-49-5	NA	Cysts/L	NA	1	NA	1	NA	1

[a] Project Action Limits (PALs) are based on the lower of:
[1] NJDEP (2008) Human Health Surface Water Quality Level - freshwater
[2] NJDEP (2008) Human Health Surface Water Quality Level - saline water
[3] USEPA (2009a) Ambient Water Quality Criterion for consumption of water and organisms
[4] USEPA (2009a) Ambient Water Quality Criterion for consumption of organisms
[5] USEPA (2011a) Maximum Contaminant Levels (MCLs)
[6] USEPA (2011b) Regional Screening Values (RSLs) for tap water
[7] NJDEP (2008) Chronic Aquatic Life Surface Water Quality Level - freshwater
[8] NJDEP (2008) Chronic Aquatic Life Surface Water Quality Level - saline water
[9] USEPA (2009a) Chronic Aquatic Life Ambient Water Quality Criterion - freshwater
[10] USEPA (2009a) Chronic Aquatic Life Ambient Water Quality Criterion - saltwater
[11] Tier II chronic values (Suter and Tsao, 1996)

[b] Project QLs are equivalent to the Achievable Laboratory Quantitation Limits.

[c] Analytical MDLs and QLs are those documented in validated methods.

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels and Analytical Method Evaluation

[d] Achievable MDLs and QLs are limits that the selected laboratory can achieve when performing the specified methods (Worksheet #23) with nominal sample volumes in the absence of interferences. Actual MDLs and QLs will vary based on sample specific factors. QLs listed for PCBs are equivalent to the Minimum Level (ML) per reference method definitions and may not be based on the low point of calibration. EDLs for isotope dilution methods are based on average blank EDL results. The actual reporting limits for isotope dilution methods will be the sample specific EDL rather than QL. All results between the MDL (or EDL) and QL will be reported as estimated values (J qualifier). The reporting limit will be the QL for all methods except isotope dilution methods.

[e] Achievable laboratory limits that are greater than the PALs are presented in boldface text. [f] Refer to Worksheet #23 for Laboratory SOPs.

[g] Note the PAHs in both the TCL SVOC and LRMS-SIM isotope dilution methods will both be reported separately.

QAPP Worksheet #16 (UFP-QAPP Manual Section 2.8.2) Project Schedule/Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Project Status	de maximis/ AECOM	Monthly	Monthly	Progress report	15th of each month
Planning and Development of Study Objectives	de maximis/ AECOM	February 2010	February 2012	QAPP/ FSP Addendum for Small Volume Sampling QAPP/ FSP Addendum for High Volume Sampling	July 2011 February 2012
Sampling events[1]	AECOM	August 2011	August 2012	Noted in monthly progress report	NA
Collection of Samples and Submission for Analysis	AECOM	August 2011	August 2012	NA	NA
Laboratory Analysis	AECOM	August 2011	September 2012	Analytical data to CPG	Beginning at 30 days after collection. See Worksheet #30 for turnaround times
Data Validation and Verification	AECOM	October 2011	October 2012 Multiple events	Data validation reports (DVRs) with data delivery	Four weeks following receipt of final laboratory data
Preparation and Delivery of Technical Memorandum to USEPA	de maximis/ AECOM	March 2012	March 2013	Technical Memoranda	March 2013

[1]Five routine events, two high flow events, and one low flow/spring tide event will be conducted during this period. Timing and duration of surveys are dependent on weather conditions and flow regimes.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach): The proposed sampling locations are presented in Figure 1 of the FSP Addendum (Appendix A) for this work. Sampling locations were chosen to provide:

(1) chemical concentration data from locations, in some instances, where physical parameters such as solids and organic carbon data have been collected during the PWCM program;

(2) spatial coverage in the LPRSA for calculation of EPCs for the HHRA, ERA, and FWM;

(3) information regarding the chemical concentrations at the model domain boundaries and at inputs to the Passaic, such as the NBSA, LPRSA tributaries, and above Dundee Dam to determine potential upgradient sources to the LPR;

(4) boundary conditions to Newark Bay and a range within Newark Bay of potential influences from the LPR; and,

(5) chemical concentration data associated with suspended solids in the water column that are likely to occur under different flows (see Worksheet #11, Project Quality Objectives).

Where the salt wedge may be present at a sampling location (stations located in RM 0 - 17.4 of the LPRSA and the NBSA), two samples will be collected: one from the upper water column (3 ft below surface) and one from the lower water column (3 ft from the bottom). These data will provide information regarding the effect of the salt wedge on the suspension and movement of chemical in the LPRSA and NBSA (i.e., are chemicals suspended in the water column near-bottom in the presence of the salt wedge). Collection of distinct freshwater and salt water data will also be used to develop salinity-based exposure concentrations for the ERA and FWM. Collection of water near-surface will provide information to the HHRA of the most likely exposure zone during human contact (e.g., swimming or boating). At locations above Dundee Dam and in the LPRSA tributaries, samples will be collected from mid-water column.

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations):

The sampling design incorporates the full extent of the lower river (RM 0 to 17.4), above Dundee Dam, LPRSA tributaries, and the NBSA and will require periodic event-based discrete sampling of target analytes in the water column. The proposed RI small volume CWCM project includes the following sampling events:

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) Sampling Design and Rationale

- Five Routine Events.
- One Low Flow/Spring Tide Event
- Two High Flow Events

The flow thresholds for the low flow and high flow events were selected from an analysis of the discharge record at Dundee Dam (April 2007 to August 2010). The low flow event threshold was identified by conducting an analysis of the number of events satisfying both the discharge criterion and the spring-tide criterion. The analysis showed that a discharge criterion of <400 cfs was satisfied multiple times (i.e., 8-12 times per calendar years 2007-2009) in each of the years over the period of record at Dundee Dam.

The high flow threshold was identified by conducting a return frequency analysis using the available discharge data at Dundee Dam. A flow event with a return period of 3 months (or 4 occurrences per year), was chosen as the flow threshold that can reasonably be expected to be exceeded during the CWCM period. Accordingly, the discharge associated with the 1 in 3 months event at Dundee Dam was calculated to be 3000 cfs and is proposed as the minimum flow for a high flow event.

Routine Events. Five Routine Events are proposed over the course of approximately one year under normal flow conditions (400 - 3,000 cfs at Dundee Dam). The events are scheduled to occur in winter (one event), spring (two events) and summer (two events) and will capture at least one spring tide and one neap tide. The sample locations will include the LPRSA (including the LPRSA tributaries), above Dundee Dam, and the NBSA (Worksheet #18). The data collected during the Routine Events will provide data to support the EPCs for the RAs and FWM. A variety of flows (ranging from 400 to 3,000 cfs at Dundee Dam) will be targeted for the Routine Events, designed to provide information regarding the variability of chemical concentrations in the study area to support the calibration and validation of the CFT model. It is anticipated the Routine Events will capture data representative of the normal influxes and mixing processes in the river and the bay, the deposition of particulates from the water column to the sediment, and of the diffusive flux of contaminants from the sediments to the water column. One hundred eight (108) samples will be collected during each of the Routine Events to be analyzed for target analytes as defined in Worksheet #15. Group A analytes will be sampled in each event. Group B analytes will be measured in one spring and two summer events. Group B analyte data will be used to validate the model and in the RI and risk assessments. Group B will not be analyzed in winter and spring, as potential exposures and biological activity are lower than in other seasons. Shallow (3 ft below surface) water stations in the five locations in the lower 17.4 miles of the LPR will be analyzed for pathogens (Worksheet #15 and #18). Group C analytes (coliform bacteria) will be analyzed in the two spring and two summer events; and Group D analytes (*Giardia* and cryptosporidium) will be sampled during the summer events. Frequency and type of QC samples are provided in Worksheet #20.

Low Flow/Spring Tide Event. One Low Flow/Spring Tide Event is proposed under low flow conditions (<400 cfs at Dundee Dam) during a Spring Tide. The sample locations will include the stations in the LPRSA and above Dundee Dam (Worksheet #18). The data collected during the Low Flow/Spring Tide Event will provide additional data in the lower reaches of the river to support the EPCs for the RAs and FWM. Combining low-flow

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) Sampling Design and Rationale

conditions with a spring tide will provide data to the CFT model when the highest tidal energies and tidal mixing may occur. Forty-four (44) samples will be collected during the Low Flow/Spring Tide Event to be analyzed for Group A and Group B target analytes as defined in Worksheet #15. Shallow (3 ft below surface) water stations in the five locations in the lower 17.4 miles of the LPR will be analyzed for Group C analytes (coliform bacteria) (Worksheet #15 and #18). Group D analytes (*Giardia* and cryptosporidium) will not be sampled during the low flow/spring tide event. Frequency and type of QC samples are provided in Worksheet #20.

High Flow Events. Two High Flow Events are proposed under storm-induced high flow (i.e., not sustained high flow) conditions (>3,000 cfs at Dundee Dam). The sample locations will include the LPRSA (including the LPRSA tributaries), above the Dundee Dam, and the NBSA (Worksheet #18). The data collected during the High Flow Events will provide data to support the EPCs for the RAs and FWM. The data will also be used to provide the CFT model preliminary information to calibrate and validate the resuspension fluxes from the sediments to the water column, and the subsequent deposition of particle-bound contaminants from the water column to the sediment under conditions where bed sediment is likely to be suspended. It is anticipated that during these events there will be a higher loading of suspended sediments (i.e., more contamination on a per unit weight suspended solids basis may occur since elevated flows associated with storm events will resuspend more bed sediment). One hundred fourteen (114) samples will be collected during each of the High Flow Events to be analyzed for target analytes as defined in Worksheet #15. Group A analytes will be measured during both events. Group B analytes will be measured in one of the two events; it is anticipated that adequate information will be obtained for the model validation from one high flow event. Shallow (3 ft below surface) water stations in the five locations in the lower 17.4 miles of the LPR will be analyzed for pathogens (Worksheet #15 and #18). Group C analytes (coliform bacteria) and Group D analytes (*Giardia* and cryptosporidium) will be sampled during both events. Frequency and type of QC samples are provided in Worksheet #20.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Routine Events						
Newark Bay North – middle of shipping channel at northern edge of Newark Bay Channel	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within Newark Bay. Potential estimation of contaminant fluxes within, to, and from Newark Bay. Provides data for NBSA RAs and, when compared to data from other stations, information to characterize potential concentration gradients of COPCs in the bay.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Newark Bay East – subtidal area midway between Newark Bay South and Newark Bay Northeast, across from Port Newark	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within Newark Bay. Potential estimation of contaminant fluxes within, to, and from Newark Bay where wind-driven suspension may occur. Provides data for NBSA RAs and, when compared to data from other stations, information to characterize potential concentration gradients of COPCs in the bay.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Newark Bay Northeast - subtidal area on eastern shore north of Branch Channel and west of Newark Bay North	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within Newark Bay. Potential estimation of contaminant fluxes within, to, and from Newark Bay where wind-driven sediment resuspension may occur. Provides data for NBSA RAs and, when compared to data from other stations, information to characterize potential concentration gradients of COPCs in the bay.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Newark Bay Northwest – subtidal area on western shore midway between Newark Bay East and Newark Bay Northeast	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within Newark Bay. Potential estimation of contaminant fluxes within, to, and from Newark Bay where wind-driven suspension may occur. Provides data for NBSA RAs and, when compared to data from other stations, information to characterize potential concentration gradients of COPCs in the bay.
Newark Bay South – eastern side of shipping channel off southern edge of Elizabeth Port Authority Marine Terminal	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within Newark Bay. Potential estimation of contaminant fluxes within, to, and from Newark Bay. Provides data for NBSA RAs and, when compared to data from other stations, information to characterize potential concentration gradients of COPCs in the bay.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Arthur Kill near Arthur Kill Park	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – exchange with the Arthur Kill. Potential estimation of contaminant fluxes between Newark Bay and the Arthur Kill.
Kill van Kull near eastern edge of Mayor Dennis P. Collins Park	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – exchange with the Kill van Kull. Potential estimation of contaminant fluxes between Newark Bay and the Kill van Kull.
Hackensack River north of the Pulaski Skyway	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – exchange with the Hackensack River. Potential estimation of contaminant fluxes between Newark Bay and the Hackensack River.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
RM 0	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events Group C in the surface samples in all spring and summer events. Group D in the surface samples in summer events.	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide Group C and Group D from one tidal phase.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – exchange between the LPR and Newark Bay.. Potential estimation of contaminant fluxes between the LPR and Newark Bay at the confluence of the LPR and Newark Bay. Provides data for salt water reach of LPR for ERA and HHRA exposures.
RM 1.4	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events Group C in the surface samples in all spring and summer events. Group D in the surface samples in summer events.	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide Group C and Group D from one tidal phase.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within the salt wedge. Potential estimation of contaminant fluxes to and from Newark Bay at a point in the LPR that is generally located within the salt water wedge. Provides data for salt water reach of LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
RM 6.7 [Tidal 1 if flow is < 1,000 cfs at Dundee Dam[d]]	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events Group C in the surface sample in all spring and summer events. Group D in the surface samples in summer events.	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide Group C and Group D from one tidal phase.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics at the upper limit of the salt wedge. Potential estimation of contaminant fluxes within the LPRSA. Location is flow-dependent. Provides estimation of chemical concentrations at edge of salt water wedge. Provides data for salt water reach of LPR for ERA and HHRA exposures.
RM 4.2 [Tidal 2 if flow is < 1,000 cfs at Dundee Dam[e]]	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events Group C in the surface samples in all spring and summer events. Group D in the surface samples in summer events.	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide Group C and Group D from one tidal phase.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within the salt wedge. Potential estimation of contaminant fluxes within the LPRSA. Location is flow-dependent. Provides estimation of chemical concentrations at midpoint of reach of the salt water wedge. Provides data for salt water reach of LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
RM 10.2 [RM 13.5 if flow < 250 cfs at Dundee Dam]	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events Group C in the surface samples in all spring and summer events. Group D in the surface samples in summer events.	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide Group C and Group D from one tidal phase.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics above the salt wedge. Potential estimation of contaminant fluxes within the LPRSA. Location is flow-dependent. Provides estimation of chemical concentrations in upper freshwater zone of the river. Provides data for freshwater reach of LPR for ERA and HHRA exposures.
Above Dundee Dam	Water	One: Mid-depth	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events	One sample: Independent of tide, but quasi-synoptic with other stations	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – loadings to the LPR. Potential estimation of contaminant fluxes to the LPRSA from upstream. Provides data for upstream freshwater reach of LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Saddle River-Saddle River Avenue Bridge	Water	One: Mid-depth	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events	One sample: Independent of tide, but quasi-synoptic with other stations	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – loadings to the LPR. Potential estimation of contaminant fluxes to the LPRSA from the watershed. Provides data for tributaries of LPR for ERA and HHRA exposures.
Second River-Washington Avenue Bridge	Water	One: Mid-depth	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events	One sample: Independent of tide, but quasi-synoptic with other stations	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – loadings to the LPR. Potential estimation of contaminant fluxes to the LPRSA from the watershed. Provides data for tributaries of LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Third River-River Road	Water	One: Mid-depth	Target Analytes. See Worksheet #15 Group A in all events Group B in one spring and two summer events	One sample: Independent of tide, but quasi-synoptic with other stations	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – loadings to the LPR. Potential estimation of contaminant fluxes to the LPRSA from the watershed. Provides data for tributaries of LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
High Flow Events						
Newark Bay North – middle of shipping channel at northern edge of Newark Bay Channel	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in both events Group B in one event	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within Newark Bay. Potential estimation of contaminant fluxes within, to, and from Newark Bay. Provides data for NBSA RAs and, when compared to data from other stations, information to characterize potential concentration gradients of COPCs in the bay.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Newark Bay East – subtidal area midway between Newark Bay South and Newark Bay Northeast, across from Port Newark	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in both events Group B in one event	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within Newark Bay. Potential estimation of contaminant fluxes within, to, and from Newark Bay where wind-driven sediment resuspension may occur. Provides data for NBSA RAs and, when compared to data from other stations, information to characterize potential concentration gradients of COPCs in the bay.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Newark Bay Northeast - subtidal area on eastern shore north of Branch Channel and west of Newark Bay North (from PWCM program)	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in both events Group B in one event	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within Newark Bay. Potential estimation of contaminant fluxes within, to, and from Newark Bay where wind-driven suspension may occur. Provides data for NBSA RAs and, when compared to data from other stations, information to characterize potential concentration gradients of COPCs in the bay.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Newark Bay Northwest – subtidal area on western shore midway between Newark Bay East and Newark Bay Northeast	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in both events Group B in one event	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within Newark Bay. Potential estimation of contaminant fluxes within, to, and from Newark Bay where wind-driven suspension may occur. Provides data for NBSA RAs and, when compared to data from other stations, information to characterize potential concentration gradients of COPCs in the bay.
Newark Bay South – eastern side of shipping channel off southern edge of Elizabeth Port Authority Marine Terminal	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in both events Group B in one event	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within Newark Bay. Potential estimation of contaminant fluxes within, to, and from Newark Bay. Provides data for NBSA RAs and, when compared to data from other stations, information to characterize potential concentration gradients of COPCs in the bay.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Arthur Kill near Arthur Kill Park	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in both events Group B in one event	Two samples: One High Slack One Low Slack	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – exchange with the Arthur Kill. Potential estimation of contaminant fluxes between Newark Bay and the Arthur Kill.
Kill van Kull near eastern edge of Mayor Dennis P. Collins Park	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in both events Group B in one event	Two samples: One High Slack One Low Slack	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – exchange with the Kill van Kull. Potential estimation of contaminant fluxes between Newark Bay and the Kill van Kull.
Hackensack River north of the Pulaski Skyway	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in both events Group B in one event	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation-exchange with the Hackensack River. Potential estimation of contaminant fluxes between Newark Bay and the Hackensack River.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
RM 0	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in both events Group B in one event Group C in the surface samples in both events. Group D in the surface samples in both events.	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb. Group C and Group D from one sample.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation - exchange between the LPR and Newark Bay. Potential estimation of contaminant fluxes between the LPR and Newark Bay at the confluence of the LPR and Newark Bay. Provides data for salt water reach of LPR for ERA and HHRA exposures.
RM 1.4	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in both events Group B in one event Group C in the surface samples in both events. Group D in the surface samples in both events.	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb. Group C and Group D from one sample.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within the salt wedge. Potential estimation of contaminant fluxes to and from Newark Bay estimated to be within the salt water wedge even at high flows. Provides data for salt water reach of LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
RM 4.2	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in both events Group B in one event Group C in the surface samples in both events. Group D in the surface samples in both events.	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb. Group C and Group D from one sample.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within the typical salt wedge. Potential estimation of contaminant fluxes within LPRSA. Provides estimation of chemical concentrations at a point typically at midpoint of reach of the salt water wedge, but likely to be upstream of salt water wedge during high flows. Provides data from the LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
RM 6.7	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in both events Group B in one event Group C in the surface samples in both events. Group D in the surface samples in both events.	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb. Group C and Group D from one sample.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation - dynamics at the typical upper limit of the salt wedge. Potential estimation of contaminant fluxes within LPRSA. Provides estimation of chemical concentrations at a location typically at the upper reach of the salt water wedge, but likely to be upstream of salt water wedge during high flows. Provides data from LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
RM 10.2	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A in both events Group B in one event Group C in the surface samples in both events. Group D in the surface samples in both events.	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb. Group C and Group D from one sample.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics above the salt wedge. Potential estimation of contaminant fluxes within the LPRSA. Provides estimation of chemical concentrations in upper freshwater zone of the river. Provides data for freshwater reach of LPR for ERA and HHRA exposures.
Above Dundee Dam	Water	One: Mid-depth	Target Analytes. See Worksheet #15 Group A in both events Group B in one event	Six samples: Samples to be collected spaced throughout the predicted storm hydrograph: three on rising limb, one near peak, two on falling limb.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – loadings to the LPR. Potential estimation of contaminant fluxes to the LPRSA from upstream. Provides data for upstream freshwater reach of LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Saddle River-Saddle River Avenue Bridge	Water	One: Mid-depth	Target Analytes. See Worksheet #15 Group A in both events Group B in one event	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – loadings to the LPR. Potential estimation of contaminant fluxes to the LPRSA from the watershed. Provides data for tributaries of LPR for ERA and HHRA exposures.
Second River-Washington Avenue Bridge	Water	One: Mid-depth	Target Analytes. See Worksheet #15 Group A in both events Group B in one event	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – loadings to the LPR. Potential estimation of contaminant fluxes to the LPRSA from the watershed. Provides data for tributaries of LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Third River-River Road	Water	One: Mid-depth	Target Analytes. See Worksheet #15 Group A in both events Group B in one event	Four samples: Samples to be collected spaced throughout the predicted storm hydrograph: two on rising limb, one near peak, one on falling limb.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – loadings to the LPR. Potential estimation of contaminant fluxes to the LPRSA from the watershed. Provides data for tributaries of LPR for ERA and HHRA exposures.
Low Flow/Spring Tide Event						
RM 0	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A, B and C. Group C in the surface sample only.	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide Group C from one tidal phase.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – exchange between the LPR and Newark Bay. Potential estimation of contaminant fluxes between the LPR and Newark Bay at the confluence of the LPR and Newark Bay. Provides data for salt water reach of LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
RM 1.4	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A, B and C. Group C in the surface sample only.	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide Group C from one tidal phase.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within the salt wedge. Potential estimation of contaminant fluxes between the LPR and Newark Bay within the salt water wedge. Provides data for salt water reach of LPR for ERA and HHRA exposures.
Tidal 1[d]	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A, B and C. Group C in the surface sample only.	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide Group C from one tidal phase.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics at the upper end of the salt wedge. Potential estimation of sediment fluxes within the LPRSA. Location is flow-dependent. Provides estimation of chemical concentrations at edge of salt water wedge. Provides data for salt water reach of LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Tidal 2[e]	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A, B and C. Group C in the surface sample only.	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide Group C from one tidal phase.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics within the salt wedge. Potential estimation of contaminant fluxes within the LPRSA. Location is flow-dependent. Provides estimation of chemical concentrations at midpoint of reach of the salt water wedge. Provides data for salt water reach of LPR for ERA and HHRA exposures.
RM 10.2 [RM 13.5 if flow < 250 cfs at Dundee Dam]	Water	Two: 3 ft below surface 3 ft from bottom	Target Analytes. See Worksheet #15 Group A, B and C. Group C in the surface sample only.	Four samples: One High Slack One Maximum Ebb Tide One Low Slack One Maximum Flood Tide Group C from one tidal phase.	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – dynamics above the salt wedge. Potential estimation of contaminant fluxes within the LPRSA. Provides estimation of chemical concentrations in upper freshwater zone of the river. Provides data for freshwater reach of LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Above Dundee Dam	Water	One: Mid-depth	Target Analytes. See Worksheet #15 Group A and B	One sample: Independent of tide, but quasi-synoptic with other stations	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – loadings to the LPR. Potential estimation of contaminant fluxes to the LPRSA from upstream. Provides data for upstream freshwater reach of LPR for ERA and HHRA exposures.
Saddle River-Saddle River Avenue Bridge	Water	One: Mid-depth	Target Analytes. See Worksheet #15 Group A and B	One sample: Independent of tide, but quasi-synoptic with other stations	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – loadings to the LPR. Potential estimation of contaminant fluxes to the LPRSA from the watershed. Provides data for tributaries of LPR for ERA and HHRA exposures.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location[a]	Matrix	Depth Intervals	Analyses	Number of Samples per Depth Interval: Number per Flow or Tidal Stage[b,c]	Sampling SOP Reference	Rationale for Sampling Location
Second River-Washington Avenue Bridge	Water	One: Mid-depth	Target Analytes. See Worksheet #15 Group A and B	One sample: Independent of tide, but quasi-synoptic with other stations	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – loadings to the LPR. Potential estimation of contaminant fluxes to the LPRSA from the watershed. Provides data for tributaries of LPR for ERA and HHRA exposures.
Third River-River Road	Water	One: Mid-depth	Target Analytes. See Worksheet #15 Group A and B	One sample: Independent of tide, but quasi-synoptic with other stations	LPR-FI-04 LPR-FI-05 LPR-FI-06	Data to support CFT model calibration and validation – loadings to the LPR. Potential estimation of contaminant fluxes to the LPRSA from the watershed. Provides data for tributaries of LPR for ERA and HHRA exposures.

[a] Specific locations can be found in Appendix A, Figure 1 and Exhibit 1.

[b] The number of samples collected per depth in the Routine and Low Flow/Spring Tide sampling events may be modified for some stations pending review of data from the first two events. Should data collected in the four intervals (i.e., high water slack tide, low water slack tide, maximum ebb tide and maximum flood tide) have low variability, this will be reviewed with USEPA and its modeling team to determine if sampling only high water slack tide and low water slack tide will achieve the PQOs.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

[c] The number of stations in Newark Bay may be modified pending review of data from the first event. Should data collected from the stations indicate low variability between Newark Bay stations, this will be reviewed with USEPA and its modeling team to determine if fewer locations will achieve the PQOs.

[d] The location of Tidal 1 (applicable when flows are < 1,000 cfs) is based on the location of the salt wedge. Tidal 1 will be located approximately one mile downstream of the predicted location of the salt wedge. See Exhibit 1 of the FSP Addendum (Appendix A).

[e] The location of Tidal 2 (applicable when flows are < 1,000 cfs) is based on the location of the salt wedge and the location of Tidal 1. Tidal 2 will be located halfway between Tidal 1 and RM 1.4, but not upstream of RM 4.2. See Exhibit 1 of the FSP Addendum (Appendix A).

QAPP Worksheet #19 (UFP-QAPP Manual Section 3.1.1) Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[a]	Sample Size[b]	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Water	VOCs	Low	C-1, C-2	120 milliliter (mL)	3 x 40mL Volatile Organics Analysis (VOA) vials	4±2°Celsius (C) , hydrochloric acid (HCl) to pH <2, store in the dark	14 days for preparation and analysis
Water	SVOCs	Low	T-7, T-2	2 Liters (L)	2 x 1L amber glass with Polytetrafluoroethylene (PTFE)-lined lid	4±2°C; store in the dark	7 days to preparation; 40 days from preparation to analysis
Water	PAHs (LRMS-SIM)	Low	T-3, T-4	2 L	2 x 1L amber glass with PTFE-lined lid	4±2°C; store in the dark	7 days to preparation; 40 days from preparation to analysis
Water	OC Pesticides	Low	T-11, T-12	2 L	2 x 1L amber glass with PTFE-lined lid	4±2°C; store in the dark	7 days to preparation; 40 days from preparation to analysis
Water	PCBs (Homologs and Congeners)	Low	T-5,T-6	2 L	2 x 1L amber glass with PTFE-lined lid	4±2°C; store in the dark	365 days for preparation and analysis
Water	PCDD/PCDFs	Low	A-1	2 L	2 x 1L amber glass with PTFE-lined lid	4±2°C; store in the dark	365 days for preparation and analysis
Water	TAL Metals and Titanium (excludes mercury)	Low	C-3, C-4, C-5, C-6	2 L	2 x 1L plastic[c]	Nitric acid (HNO_3) to pH<2	180 days (6 months) for preparation and analysis
Water	Metals[d], excluding mercury (dissolved)	Low	C-3, C-4, C-5, C-6	2 L	2 x 1L plastic[c]	Field filter (0.45 micron [um]) and preserve with HNO_3 to pH<2	180 days (6 months) for preparation and analysis

QAPP Worksheet #19 (UFP-QAPP Manual Section 3.1.1) Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[a]	Sample Size[b]	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Water	Low Level Mercury	Low	B-1	500 mL	2 x 250mL PTFE with PTFE-lined lids	4±2°C during shipment; Samples must be preserved or analyzed within 48 hours of collection. Samples will be oxidized by addition of 5mL/L BrCl to original sampling container. Oxidation of the sample within the original container will extend the time to preservation to 28 days	28 days to analysis if preserved 48 hours to analysis if unpreserved
Water	Low Level Mercury (dissolved)	Low	B-1	500 mL	2 x 250mL PTFE with PTFE-lined lids	Field filter (0.45 um) and 4±2°C during shipment; Samples must be preserved or analyzed within 48 hours of collection. Samples will be oxidized by addition of 5mL/L BrCl to original sampling container. Oxidation of the sample within the original container will extend the time to preservation to 28 days.	28 days to analysis if preserved 48 hours to analysis if unpreserved

QAPP Worksheet #19 (UFP-QAPP Manual Section 3.1.1) Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[a]	Sample Size[b]	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Water	Methyl Mercury	Low	B-2	500 mL	2 x 250mL PTFE with PTFE-lined lids	Preserve at collection with 0.2% (volume to volume [v/v]) 18 Molar (M) sulfuric acid (H_2SO_4); store in the dark; at 4±2ºC.	90 days to analysis if preserved 48 hours to analysis if unpreserved
Water	Methyl Mercury (dissolved)	Low	B-2	500 mL	2 x 250mL PTFE with PTFE-lined lids	Field filter (0.45 um) and preserve at collection with 0.2% (v/v) 18 M H_2SO_4; store in the dark; at 4±2ºC.	90 days to analysis 48 hours to analysis if unpreserved
Water	Hexavalent Chromium	Low	C-15	250 mL	2 x 125mL plastic	Field filter (0.45 um) and preserve with buffer to pH 9.3-9.7, store at 4±2°C,adjust on receipt if pH not within limits	28 days to analysis if preserved 24 hours to analysis if unpreserved
Water	Butyltins	Low	C-8	1 L	1L amber glass with PTFE-lined lid	4±2°C	7 days to preparation, 40 days from preparation to analysis
Water	Ammonia-N	Low	C-9	100 mL	125mL plastic	4±2°C, H_2SO_4 to pH<2	28 days to analysis
Water	Chlorophyll a	Low	C-22	2 L	2 x 1L amber glass with PTFE-lined lid	4±2°C	Ship to the laboratory and filter within 48 hours of collection. Filters must be frozen, stored in the dark, and analyzed within 24 days

QAPP Worksheet #19 (UFP-QAPP Manual Section 3.1.1) Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[a]	Sample Size[b]	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Water	Cyanide	Low	C-10	500 mL	2 x 250mL glass or plastic	4±2º C, sodium hydroxide (NaOH) to pH > 12	14 days to analysis
Water	TKN	Low	C-12	1 L	1L glass or plastic	4±2°C, H_2SO_4 to pH<2	28 days to analysis
Water	Total Phosphorus	Low	C-11	250 mL	250mL glass or plastic	4±2º C; H_2SO_4 to pH < 2	28 days to analysis
Water	TOC	Low	C-13	120 mL	3 x 40mL amber glass vials with PTFE-lined lids	4±2º C; H_2SO_4 to pH < 2	28 days to analysis
Water	POC/DOC	Low	C-13, C-16	600 mL	3 x 200mL plastic	4±2°C	Ship to the laboratory and filter using a 0.7um glass fiber filter within 48 hours. Filters and filtrates must be analyzed within 28 days
Water	Total Sulfide	Low	C-14	100 mL	125mL plastic	4±2°C , NaOH to pH >9 +/Zinc Acetate	7 days to analysis
Water	SSC	Low	C-17	2 L	Two tared 1-L plastic	4±2°C; store in the dark; weigh entire sample bottle to nearest 0.1 g and record weight upon receipt at laboratory	28 days to analysis
Water	TDS	Low	C-19	400 mL	2 x 250mL glass or plastic	4±2°C	7 days to analysis
Water	Alkalinity	Low	C-20	400 mL	2 x 250mL glass or plastic	4±2°C	14 days to analysis

QAPP Worksheet #19 (UFP-QAPP Manual Section 3.1.1) Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[a]	Sample Size[b]	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Water	Sulfate, Chloride	Low	C-21	50 mL	125mL glass or plastic	4±2°C	28 days to analysis
Water	Bacteria	Low	E-1, E-2, E-3, E-4	400 mL	4 x 125mL glass or plastic sterile containers	1-10°C	6 hours to analysis
Water	Protozoans	Low	S-1	1-10L[e]	1 x 10L carboy	1-20°C	96 hours from collection to filtration

[a] Refer to Worksheet #23 for SOP titles and methods

[b] Sample size is the minimum requested by each laboratory to perform the requested analysis; minimum sample size requirements reflect the additional sample needed to permit re-extraction and re-analysis . Additional sample volume is needed for field QC samples (e.g., matrix spikes).

[c] High or low density polyethylene or polypropylene plastics will be acceptable.

[d] Metals to be analyzed in filtered samples are arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc.

[e] Exact sample size collected and filtered is dependent on suspended sediment concentration.

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) Field Quality Control Sample Summary Table

Matrix	Analytical Group	Conc. Level	Analytical and Preparation SOP Reference [a]	No. of Sampling Locations (No. of Samples)	No. of Field Duplicates[b]	No. of Rinsate Blanks [c]	No. of Trip Blanks[d]	No. of PE Sample[e]	Total No. of Samples to Lab
Water	VOCs	Low	C-1, C-2	17[f] (482)	25	32	20	5	564
Water	SVOCs	Low	T-7, T-2	17[f] (482)	25	32	NA	5	544
Water	PAHs and Alkyl PAHs - LRMS-SIM	Low	T-3, T-4	17[f] (482)	25	32	NA	5	544
Water	OC Pesticides	Low	T-11, T-12	17[f] (482)	25	32	NA	9	548
Water	PCBs (Homologs and Congeners)	Low	T-5, T-6	17[f] (812)	41	32	NA	9	894
Water	PCDD/PCDFs	Low	A-1	17[f] (812)	41	32	NA	9	894
Water	Alkalinity	Low	C-20	17[f] (812)	41	32	NA	0	85
Water	SSC	Low	C-17	17[f] (812)	41	32	NA	NA	885
Water	TAL Metals (excluding mercury, cadmium, copper and lead), Titanium, hardness (by calculation)	Low	C-3, C-4, C-5, C-6, C-18	17[f] (482)	25	32	NA	10[g]	549
Water	Cadmium, copper and lead	Low	C-3, C-4, C-5, C-6	17[f] (812)	41	32	NA	10[g]	895
Water	Metals (dissolved) (excluding mercury, cadmium, copper and lead)	Low	C-3, C-4, C-5, C-6	17[f] (482)	25	32	NA	NA[g]	539
Water	Cadmium, copper and lead (dissolved)	Low	C-3, C-4, C-5, C-6	17[f] (812)	41	32	NA	NA[g]	885
Water	Sulfate and Chloride	Low	C-21	17[f] (812)	41	32	NA	0	885

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) Field Quality Control Sample Summary Table

Matrix A	nalytical Group	Conc. Level	Analytical and Preparation SOP Reference [a]	No. of Sampling Locations (No. of Samples)	No. of Field Duplicates[b]	No. of Rinsate Blanks [c]	No. of Trip Blanks[d]	No. of PE Sample[e]	Total No. of Samples to Lab
Water	Low Level Mercury	Low	B-1	17[f] (812)	41	32 NA		5	890
Water	Low Level Mercury (dissolved) Lo	w	B-1	17[f] (812)	41	32 NA		NA	885
Water	Methyl Mercury	Low	B-2	17[f] (482)	25	32 NA		5	544
Water	Methyl Mercury (dissolved) Lo	w	B-2	17[f] (482)	25	32 NA		NA	539
Water	Hexavalent Chromium	Low	C-15	17[f] (482)	25	32 NA		5	551[h]
Water	Butyltins Lo	w	C-7, C-8	17[f] (482)	25	32 NA		5	544
Water	Bacteria Lo	w	E-1, E-2, E-3, E-4	5[f] (35)	2	8 NA		NA	45
Water	Protozoans Lo	w	S-1	5[f] (20)	2	NA NA		0	22
Water	Ammonia-N Lo	w	C-9	17[f] (482)	25	32 NA		0	539
Water	Cyanide Lo	w	C-10	17[f] (482)	25	32 NA		0	539
Water	TKN L	ow	C-12	17[f] (482)	25	32 NA		0	539
Water	Total Phosphorus	Low	C-11	17[f] (482)	25	32 NA		0	539
Water	TOC Lo	w	C-13	17[f] (812)	41	32 NA		0	885
Water	DOC Lo	w	C-13	17[f] (812)	41	32 NA		0	885
Water	POC Lo	w	C-16	17[f] (812)	41	32 NA		NA	885
Water	Total Sulfide	Low	C-14	17[f] (812)	41	32 NA		0	885
Water	TDS Lo	w	C-19	17[f] (812)	41	32 NA		0	885
Water	Chlorophyll a	Low	C-22	17[f] (812)	41	32 NA		1	886

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) Field Quality Control Sample Summary Table

a. Refer to Worksheet #23 for SOP title and method

b. Field duplicates will be collected at a frequency of 1 per 20 samples unless noted otherwise.

c. Equipment rinsate blanks will be collected at a frequency of one per sampling event per sampling team for each set of decontaminated equipment utilized for a particular task. The total number of rinsate blanks is estimated based on details in Worksheet #18 and the FSP Addendum and may change as the program progresses. This estimate assumes four teams per eight events.

d. Trip blanks will be associated with VOCs. One trip blank will be included in each cooler transporting VOC samples to the laboratory; the number in this column is therefore an estimate and assumes VOCs will be collected each of the 4 days in the 5 events where Group B analytes are collected.

e. PE (also known as Proficiency Testing) Samples for the program will be obtained from Wibby Environmental or R.T.Corporation. Refer to Worksheet #31 for a description of the PE program for the CWCM. This total includes certified reference material (CRM) and Quality Control Check Samples (QCCS) samples that will be analyzed at laboratories as part of their method or on-going QC programs, as well as the pre-program PE samples.

f. Refer to Worksheet #18 and the FSP Addendum for details of sampling locations and monitoring event schedule. Sampling locations will vary based on tide stage and river flow for two tidal stations during the Routine (flows < 1,000 cfs at Dundee Dam) and Low Flow/Spring Tide Events. The number of stations per event is fixed at 17 for Routine Events (when flows > 1,000 cfs at Dundee Dam) and for High Flow Events. When flows are < 1,000 cfs at Dundee Dam, two stations within the LPRSA (Tidal 1 and Tidal 2) may move, based on the location of the salt wedge. See FSP Addendum Exhibit 1 (Appendix A).

g. PE samples for both freshwater and saltwater matrices. Metals PE samples will be analyzed for total metals only.

h. Total number includes field buffer blanks, which are supplied by the laboratory and consist of DI water, the preservative, and the buffer. Field buffer blanks will be initated with Routine Event #3. Seven field buffer blanks are estimated – one for Routine Event #3, and two each for Routine Event #5, one of the high flow events, and the low flow event.

QAPP Worksheet #21 (UFP-QAPP Manual Section 3.1.2) Project Sampling SOP References Table

The following is a list of all SOPs associated with project sampling including, but not limited to, sample collection, field measurements, sample preservation, equipment cleaning and decontamination, equipment testing, inspection and maintenance, supply inspection and acceptance, and sample handling and custody.

Reference Number	Title, Revision Date and/or Number[a]	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
LPR-G-01	Field Records, Rev. 7	AECOM N	A	No	Appendix B
LPR-G-02	Navigation/Positioning, Rev. 5	AECOM	Differential Global Positioning System (dGPS)	No Appe	ndix B
LPR-G-03	Equipment Decontamination, Rev. 5	AECOM	Various – see Appendix B	No Appe	ndix B
LPR-G-04	Investigation Derived Waste (IDW) Handling and Disposal, Rev. 5	AECOM	Various – see Appendix B	No Appe	ndix B
LPR-G-05	Sample Custody, Rev. 6	AECOM	NA	No	Appendix B
LPR-G-06	Packaging and Shipping, Rev. 5	AECOM	NA	No	Appendix B
LPR-FI-04	Small Volume Surface Water Sampling/Chemical Data Collection, Rev. 3	AECOM	Peristaltic pump, trigger-activated bottle sampler	Yes. Trigger-activated bottle sampler will not be used.	Appendix B
LPR-FI-05	Water Column Profiling, Rev. 2	AECOM	Datasonde	No	Appendix B
LPR-FI-06	Small Volume Surface Water Sampling for Trace Metals, Rev. 3	AECOM Pe	ristaltic pump	No	Appendix B

[a]Current USEPA-approved version will be used at the time work is conducted.

Procedural modifications to these documents may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification will be approved in advance by the Project QA Manager, CWCM Task Manager, the CPG Coordinator and the USEPA RPM. Deviations will be documented in the field records.

QAPP Worksheet #22 (UFP-QAPP Manual Section 3.1.2.4) Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference[1]
YSI	Temperature sensors are factory calibrated. Conductivity, pH, salinity are calibrated against fixed calibration solutions. Dissolved oxygen calibrated in air.	Battery checks performed every morning before use, and charged every evening after use. All probes will be kept clean of debris and membranes free of tears.	Calibrate per manufacturer's specifications (Section 2.6 of manual, provided with equipment).	Daily for functionality	Daily or recalibrate as needed	Dissolved Oxygen goal is ± 0.5 mg/L of saturation in air. pH goal is ± 0.3 with buffer solutions Conductivity goal is ±10% of standard. Salinity goal is ± 10% of standard.	Recalibrated or replaced	AECOM FTM or designee	LPR-FI-05

[1]Refer to the Project Sampling SOP References table (Worksheet #21).

QAPP Worksheet #23 (UFP-QAPP Manual Section 3.2.1) Analytical SOP References Table[a]

Reference Number	Primary Method Reference[b]	Laboratory SOP[c] Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instruments	Organization Performing Analysis	Modified for Project work? (Y/N)
C-1	EPA 8260B[d]	Volatile Organic Compounds by GC/MS, VOC 8260, Rev. 14, 11/20/2009	Definitive	Organics (VOCs Analysis)	GC/MS	CAS-Kelso, WA	Y, Use low standard to reduce QL.
C-2	EPA 5030[d]	Purge and Trap for Aqueous Samples, VOC-5030, Rev.4, 4/3/2007	Definitive	Organics (VOCs Sample Preparation)	P&T	CAS-Kelso, WA	N
T-2	EPA 8270C[d]	Semivolatile Organic Analysis by GC/MS: Method(s): SW-846 8270C and EPA 625, PT-MS-001, Rev.11,11/17/2009	Definitive	Organics (SVOCs)	GC/MS	TestAmerica-Pittsburgh, PA	N
T-3	EPA 3520C[d]	Extraction of Selected Semivolatile Organic Compounds and Alkylated PAHs for Analysis by GC/MS-SIM, KNOX-OP-0023, Rev. 0, 1/12/2010	Definitive	Organics (Sample Preparation)	N/A	TestAmerica-Knoxville, TN	Y, Cleanup by Gel Permeation Cleanup (GPC) and silica gel
C-3	EPA 3010A[d]	Metals Digestion, MET-3010A, Rev. 10, 7/12/2007	Definitive	Metals (Sample Preparation-Aqueous)	N/A	CAS-Kelso, WA	N
T-4	CARB 429[e]	Isotope Dilution Analysis of Selected Semivolatile Organic Compounds and Alkylated PAHs by Gas Chromatography/Mass Spectrometry-Selected Ion Monitoring (GC/MS-SIM), KNOX-ID-0016, Rev. 8, 8/13/2010	Definitive	Organics (PAHs)	High Resolution Gas Chromatography, Low Resolution Mass Spectrometry via Selected Ion Monitoring (HRGC/LRMS-SIM)	TestAmerica-Knoxville, TN	N

QAPP Worksheet #23 (UFP-QAPP Manual Section 3.2.1) Analytical SOP References Table[a]

Reference Number	Primary Method Reference[b]	Laboratory SOP[c] Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instruments	Organization Performing Analysis	Modified for Project work? (Y/N)
T-5	EPA 1668A[f]	Extraction of Polychlorinated Biphenyl (PCB) Isomers for Analysis by Isotope Dilution HRGC/HRMS, KNOX-OP-0021, Rev. 1, 2/1/2011	Definitive	Organics (Sample Preparation)	N/A	TestAmerica-Knoxville, TN	N
T-6	EPA 1668A[f]	Analysis of Polychlorinated Biphenyl (PCB) Isomers by Isotope Dilution HRGC/HRMS, KNOX-ID-0013, Rev. 9, 1/7/2010	Definitive	Organics (PCB Congeners)	HRGC/ High Resolution Mass Spectrometry (HRMS)	TestAmerica-Knoxville	N
T-7	EPA 3520C[d]	Extraction and Cleanup of Organic Compounds from Waters Solids, Tissues and Wipes, PT-OP-001, Rev. 13, 3/11/2011	Definitive	Organics (Sample Preparation)	N/A	TestAmerica-Pittsburgh, PA	N
T-11	EPA 1699[f]	Analysis of Organochlorine Pesticides By High Resolution Gas Chromatography/High Resolution Mass Spectrometry, WS-ID-0014, Rev. 5.3, 11/17/2010	Definitive	Organics (OC Pesticides)	HRGC/HRMS	TestAmerica-West Sacramento, CA	Y, Deactivated silica gel cleanup (described in method) required, reference method QC criteria, rather than SOP limits, must be used to flag exceedances in the report narrative

QAPP Worksheet #23 (UFP-QAPP Manual Section 3.2.1) Analytical SOP References Table[a]

Reference Number	Primary Method Reference[b]	Laboratory SOP[c] Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instruments	Organization Performing Analysis	Modified for Project work? (Y/N)
C-4	EPA 6010C[d]	Determination of Metals and Trace Elements by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP), MET-ICP, Rev. 22, 7/30/2010	Definitive	Metals	ICP/AES	CAS-Kelso, WA	N
T-12	EPA 3640A[d]	Gel Permeation Cleanup [Method 3640A], WS-OP-0012, Rev. 4, 10/5/2007	Definitive	Organics (OC Pesticides)	GPC	TestAmerica-West Sacramento, CA	N
C-5	EPA 6020A[d]	Determination of Metals and Trace Elements by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), EPA Method 6020, MET-6020, Rev. 14, 4/10/2010	Definitive	Metals	ICP/MS	CAS-Kelso, WA	N
C-6[g]	EPA 1640[f]	Trace Metals in Water by Pre-Concentration Using Reductive Precipitation Followed by ICP-MS Analysis, MET-RPMS, Rev. 5, 2/14/08	Definitive	Metals (Sample Preparation)	N/A	CAS-Kelso, WA	N
C-7	Krone[h]	Extraction of Organotins in Sediment, Water, and Tissue Matrices, EXT-OSWT, Rev. 6, 11/25/2009	Definitive	Organics (Sample Preparation)	N/A	CAS-Kelso, WA	N

QAPP Worksheet #23 (UFP-QAPP Manual Section 3.2.1) Analytical SOP References Table[a]

Reference Number	Primary Method Reference[b]	Laboratory SOP[c] Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instruments	Organization Performing Analysis	Modified for Project work? (Y/N)
C-8	Krone[h]	Butyltins, SOC-BUTYL, Rev. 9, 10/2/2009	Definitive	Organics (Butyltin)	GC/Flame Photoionization Detector (FPD)	CAS-Kelso, WA	N
C-9	SM 4500-NH3G[i]	Ammonia by Flow Injection Analysis, GEN-350.1, Rev. 8, 4/13/2010	Definitive	General Chemistry	Rapid Flow Analyzer Colorimeter	CAS-Kelso, WA	N
C-10	EPA 335.2[j]	Total Cyanides and Cyanides Amenable to Chlorination, GEN-CN, Rev. 16, 12/30/2010	Definitive	General Chemistry	Lachat Quik-Chem Analyzer	CAS-Kelso, WA	N
C-11	EPA 365.3[j]	Phosphorus Determination Using Colorimetric Procedure, GEN-365.3, Rev. 10, 8/28/2008	Definitive	General Chemistry	Ultraviolet-Visible Spectrophotometry (UV-VIS)	CAS-Kelso, WA	N
C-12	ASTM D 3590/ D 1426[k]	Nitrogen, Total and Soluble Kjeldahl, GEN-TKN, Rev. 10, 1/7/2008	Definitive	General Chemistry	Ion Selective Electrode	CAS-Kelso, WA	N
C-13	SM 5310C[i]	Total Organic Carbon in Water, GEN-TOC, Rev. 11, 2/19/2010	Definitive	General Chemistry	TOC Analyzer (Persulfate Oxidation Method)	CAS-Kelso, WA	N, note DOC and POC will be performed on samples from the same container
C-14	SM 4500-S2F[i]	Total Sulfides by Methylene Blue Determination, GEN-9030, Rev. 10, 1/7/2010	Definitive	General Chemistry	UV-VIS	CAS-Kelso, WA	N
C-15	EPA 218.6[l]	Hexavalent Chromium by Ion Chromatography, GEN-7199, Rev. 3, 1/13/2011	Definitive	Metals	Ion Chromatography	CAS-Rochester, NY	N, use of low level method option required

QAPP Worksheet #23 (UFP-QAPP Manual Section 3.2.1) Analytical SOP References Table[a]

Reference Number	Primary Method Reference[b]	Laboratory SOP[c] Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group Ins	truments	Organization Performing Analysis	Modified for Project work? (Y/N)
C-15 EPA	218.6[l]	Hexavalent Chromium by Ion Chromatography for Waters and Soil Extracts by Methods 218.6, 218.7, and 7199, GEN-7199, Rev. 4, 2/29/2012; SOP Change Form, effective date 4/2/12.	Definitive Me	tals	Ion Chromatography	CAS-Rochester, NY	N, use of low level method option required
A-1 EPA	1613B[l]	Polychlorinated Dibenzodioxin/ Furans USEPA Methods 8290,1613, 23, 0023A, and TO-9A, AP-CM-5, Rev.15, 9/02/2010	Definitive	Organics (PCDD/PCDFs)	Isotope Dilution Mass Spectrometry	Analytical Perspectives, NC	N
A-2 EPA	1613B[l]	PCDD/Fs in Water by SPE AP-SP-E5, Rev.10, 10/12/2008	Definitive	Organics (Sample Preparation)	N/A	Analytical Perspectives, NC	N
B-1 EPA	1631[l]	Procedure for EPA Method 1631, Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry, BR-0006, Rev. 004e, 5/24/2010	Definitive	Metals (Total Low Level Mercury)	Cold Vapor Atomic Fluorescence (CVAFS)	Brooks Rand-Seattle, WA	N

QAPP Worksheet #23 (UFP-QAPP Manual Section 3.2.1) Analytical SOP References Table[a]

Reference Number	Primary Method Reference[b]	Laboratory SOP[c] Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instruments	Organization Performing Analysis	Modified for Project work? (Y/N)
C-16	EPA 440[m]	Sample Preparation for Particulate Carbon and Nitrogen and Particulate Organic Carbon in Water by Combustion / Thermo-Conductivity or Infrared Detection, GEN-PC PN POC PREP, Rev. 01, 7/3/09	Definitive	General Chemistry	TOC Analyzer	CAS-Tucson, AZ	N, note the nominal pore size of the GF/F filter used must be 0.7 um. POC and DOC will be performed on sample from the same container,
C-17	ASTM D 3977[k]	Standard Test Methods for Determining Sediment Concentration in Water Samples, GEN-3977, Rev. 0, 7/11/2011	Definitive	General Chemistry	Gravimetric	CAS-Kelso, WA	N, Note Test Option B without the 14 day settling time will be used. The nominal pore size of the GF/F filter used must be 0.7 um.
C-18	SM 2340B[i]	Hardness, Total, GEN-2340, Rev. 7,12/18/2009	Definitive	General Chemistry	Calculation	CAS-Kelso, WA	N
C-19	SM 2540C[i]	Solids, Total Dissolved (TDS), GEN-TDS, Rev. 8, 3/19/2010	Definitive	General Chemistry	Gravimetric	CAS-Kelso, WA	N
C-20	SM 2320B[i]	Alkalinity, Total, GEN-2320, Rev. 7, 3/1/2010	Definitive	General Chemistry	Titrimetric	CAS-Kelso, WA	N
C-21	EPA 9056A[d]	Ion Chromatography, GEN-IONC, Rev.14, 3/1/2010	Definitive	General Chemistry	Ion Chromatography (IC)	CAS-Kelso, WA	N

QAPP Worksheet #23 (UFP-QAPP Manual Section 3.2.1) Analytical SOP References Table[a]

Reference Number	Primary Method Reference[b]	Laboratory SOP[c] Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instruments	Organization Performing Analysis	Modified for Project work? (Y/N)
C-22	SM 10200-H[i]	Chlorophyll a by Colorimetry, GEN-CHLOR, Rev. 0, 5/25/2010	Definitive	General Chemistry	UV-VIS Spectrophotometer	CAS-Kelso, WA	N
E-1	SM 9223B[i]	Chromogenic Substrate Coliform Test – Colilert, M017, Rev. 4, 3/10/2010	Definitive	Microbiological (Bacteria)	Incubator, Ultraviolet Lamp, Thermometer, pH Meter	EMSL, NJ	N
E-2	SM 9222D[i]	Standard Operating Procedure for Fecal Coliform by Membrane Filtration, M019, Rev.1.3, 1/1/2008	Definitive	Microbiological (Bacteria)	Incubator, Thermometer, pH Meter	EMSL, NJ	N
E-3	SM 9230C[i]	Standard Operating Procedure for the Detection and Enumeration of Fecal Streptococci in Water by Membrane Filtration Using m-Enterococcus Agar, M020, Rev.1.2, 3/1/2006	Definitive	Microbiological (Bacteria)	Incubator, Thermometer, pH Meter	EMSL, NJ	N
E-4	SM 9230C[i]	Standard Operating Procedure for The Detection and Enumeration of *Enterococci* in Water by Membrane Filtration Using membrane-Enterococcus-Esculin Iron Agar (mE-EIA), M029, Rev.1.1 3/1/2006	Definitive	Microbiological (Bacteria)	Incubator, Thermometer, pH Meter	EMSL, NJ	N

QAPP Worksheet #23 (UFP-QAPP Manual Section 3.2.1) Analytical SOP References Table[a]

Reference Number	Primary Method Reference[b]	Laboratory SOP[c] Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instruments	Organization Performing Analysis	Modified for Project work? (Y/N)
S-1	EPA 1623[f]	Standard Operating Procedure for Method 1623: Cryptosporidium and Giardia in Water by Filtration/IMS/FA, Modified for Special Project Water Matrices and Use of Colorseed™, ASI SOP No. ASI224-8, Rev. 0, 9/10/2010	Definitive	Microbiological (Protozoa)	Microscope	Analytical Services, Inc., VT	Y, Section 9.3.5.10 is modified to add the following two sentences: "Leave the slides on the slide warmer for approximately 10 minutes after all slides are visibly dry. Place the slides on a tray and place in incubator (41.0 +/- 1.0 deg. C for 15 +/- 1 minutes)."

QAPP Worksheet #23 (UFP-QAPP Manual Section 3.2.1) Analytical SOP References Table[a]

[a] All SOPs are contained in Appendix C-1.

[b] Complete references are provided in Attachment 1.

[c] It is expected that the procedures outlined in these SOPs will be followed. Procedural modifications to individual SOPs may be warranted depending upon an individual sample matrix, interferences encountered, or limitations imposed by the procedure. Deviations from individual SOPs will be documented in the laboratory records. Substantive modification to any SOP will be approved in advance by the Project QA Manager and CWCM Task Manager and communicated to the CPG Coordinator and to the USEPA Remedial Project Manager for pre-approval before implementation. Examples of substantive modifications include changes to QA/QC requirements or control limits, changes other than required dilutions that affect sensitivity, and any changes that adversely affect the selectivity of the analyte detection. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity. Note the laboratory SOPs may contain default control limits, which are superceded by statistically derived control limits. If current statistically derived QC control limits are available; these current QC control limits are presented in Worksheet #12 and Worksheet #28 in place of the default limits presented in the SOPs, or presented in Attachment C-2 and incorporated by reference. Note laboratory updates to statistical control limits may occur during program execution.

[d] USEPA 2008a

[e] CARB 1997

[f] USEPA 2010b

[g] This SOP will be used for the applicable elements when sample salinity exceeds 1/20 that of seawater in order to avoid dilutions and improve sensitivity.

[h] Krone,C.A. *et al* 1988

[i] APHA 1998

[j] USEPA 1983

[k] ASTM 2010

[l] USEPA 2010a

[m] USEPA 1997

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference[a]
GC/MS (VOC)	Bromofluorobenzene (BFB) tune; Initial and Continuing Calibration as Required in SOP	Verify tuning every 12 hours; initial calibration after instrument set up, after major instrument changes and when continuing calibration criteria are not met.	Initial calibration (ICAL) % RSD ≤30% for Calibration Check Compound (CCCs); ICAL % RSD ≤15% or linear curve r≥ 0.995, or quadratic curve $r^2 \geq 0.990$. Initial Calibration Verification (ICV) and Continuing calibration verification (CCV) percent deviation (%D) ≤20% for CCCs; system performance check compounds (SPCC) minimum average Response factors (RF).	Inspect system, correct problem, rerun calibration and affected samples	Analyst	C-1
GC/MS (SVOC)	Decafluorotriphenylphosphine (DFTPP) tune; Initial and Continuing Calibration as required in SOP	Verify tune every 12 hours; Initial calibration after instrument set up, after major instrument changes and when continuing calibration criteria are not met.	ICAL %RSD ≤30% for CCCs; ICAL %RSD ≤15% or linear curve r ≥ 0.995, or quadratic curve $r^2 \geq 0.990$. CCV %D ≤20% for CCCs; SPCC minimum avg. RF is 0.050	Inspect system, correct problem, rerun calibration and affected samples	Analyst	T-2

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference[a]
LRMS-SIM (PAH and Alkyl PAHs)	DFTPP tune; Initial and Continuing Calibration as required in SOP	Verify tune every 12 hours using perfluorotributylamine; Initial calibration after instrument set up, after major maintenance, and/or instrument changes have occurred	ICAL %RSD ≤30% CCV %D ≤30%. ICV %D ≤30%.	Inspect system, correct problem, rerun calibration and affected samples	Analyst	T-4
HRGC/HRMS (OC Pesticides)	Instrument tuning, initial and continuing calibration as required in SOP	Initial calibration after instrument set up, after major maintenance and/or instrument changes have occurred. Calibration verification minimum every 12 hours	RSD for mean relative response factors (RRF) calibrated by isotope dilution ≤ 20%; all other compounds ≤ 30%; initial calibration verification (ICV) ≤ 30% of true value. Refer to Appendix C-2 for internal precision recovery (IPR) and calibration verification (VER) criteria.	Inspect system, correct problem, rerun calibration and affected samples	Analyst	T-11

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference[a]
HRGC/HRMS (PCB Congeners and Homologs)	Retention time calibration, initial calibration, continuing calibration as required in SOP	Initial calibration after instrument set up, after major instrument changes and when continuing calibration criteria are not met. Calibration verification minimum every 12 hours	ICAL %RSD ≤ 20% for target analytes calculated by isotope dilution. ICV %D < 50% for all targets and <35% for all but 4 target analytes %RSD ≤ 35% for target analytes calculated by internal standard. CCV ≤ 30% Drift for Toxics and LOC congeners CCV 40-160% for non-Toxic congeners. Refer to Appendix C-2 for IPR and VER criteria.	Inspect system, correct problem, rerun calibration and affected samples	Analyst	T-6
Isotope Dilution Mass Spectrometry (PCDD/PCDFs)	Perfluorokerosene (PFK) Tune; initial and continuing calibration as required in SOP	Initial calibration after instrument set up, after major instrument changes and when continuing calibration criteria are not met. Continuing calibration minimum every 12 hours	%RSD for mean response of unlabeled standards ≤ 10%; labeled reference compounds ± 20% Continuing calibration using Batch Control Spike (BCS_3) per SOP. Refer to Appendix C-2 for IPR criteria.	Inspect system, correct problem, rerun calibration and affected samples	Analyst	A-1
ICP/AES (Metals)	Initial and continuing calibration per SOP	Profile instrument; Copper/Manganese (Cu/Mn) ratio daily; blank, RL and high standard daily; Interference Check Sample (ICS) at start and every 8 hours; Continuous calibration check (CCB), CCV every 10 samples	Cu/Mn ratio within 20% of value at time interelement corrections (IECs) determined. ICV, CCV ± 10% of true value; ICSAB ± 20% of true value	Inspect system, correct problem, rerun calibration and affected samples	Analyst	C-4

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference[a]
ICP/MS (Metals)	Initial and continuing calibration per SOP	Intensity check, Cu/Mn ratio ; blank, RL and high standard daily; ICS at start and every 8 hours; CCB, CCV every 10 samples	Cu/Mn ratio within 20% of value at time IECs determined. ICV, CCV ± 10% of true value; ICSAB ± 20% of true value; mass spectrometer tuning criteria per SOP C-5	Inspect system, correct problem, rerun calibration and affected samples	Analyst	C-5
CVAFS (Mercury)	Initial and continuing calibration per SOP	Calibrate daily with a calibration blanks (CB) (1 per split bottle/bubbler used), minimum of 5 standards, and ICV daily. Analyze CCV every 10 samples. Analyze carryover blank following any result ≥20,000 pg.	CB: each ≤40 pg; average ≤20 pg; standard deviation ≤7.5 pg ICV 85 -115% CCV 77-123% (total mercury) Carryover blank: ≤40 pg and within ± 20 pg of average CB	Inspect system, correct problem, rerun calibration and affected samples	Analyst	B-1
CVAFS (Methyl Mercury)	Initial and continuing calibration per SOP	Calibrate daily with ethylation blanks, minimum of 5 standards, and ICV daily. Analyze CCV every 10 samples. Analyze carryover blank following any result ≥2x the concentration of the high calibration standard	Ethylation Blank: <QL ICV 80 -120% CCV 67 -133% Carryover blank: <QL IPR and OPR criteria per reference method	Inspect system, correct problem, rerun calibration and affected samples	Analyst	B-2
IC (Hexavalent Chromium, Sulfate, Chloride)	Initial and continuing calibration per SOP	Calibrate daily using a minimum of a blank and 3 standards; r ≥ 0.999; CCB, CCV every 10 samples	ICV, CCV ± 10% of true value; CCB <QL	Inspect system, correct problem, rerun calibration and affected samples	Analyst	C-15, C-21

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference[a]
GC/FPD (Butyltins)	Initial and continuing calibration per SOP	External calibration prior to each use; continuing calibration every 10 injections or every 12 hours whichever is more frequent	ICAL RSD <20% ICV, CCV ± 25% of true value	Inspect system, correct problem, rerun calibration and affected samples	Analyst	C-8
UV-VIS (Sulfides and Chlorophyll a)	Initial and continuing calibration per SOP	Allow spectrophotometer to warm up for 30 minutes. External calibration prior to each use; r ≥ 0.995; CCB, CCV every 10 samples	ICV, CCV ± 10% of true value	Inspect system, correct problem, rerun calibration and affected samples	Analyst	C-14, C-22
Rapid Flow Analyzer Colorimeter (Ammonia-N)	Initial and continuing calibration per SOP	Determine Linear Calibration range at initial calibration and verify at least every 6 months using a blank and 3 standards; r > 0.995; CCB, CCV every 10 samples	Linearity check must be within ± 10% of original values; CCB <QL; ICV, CCV ± 10% of true value	Inspect system, correct problem, rerun calibration and affected samples	Analyst	C-9
Automated Ion Rapid Flow Analyzer (Cyanide)	Initial and continuing calibration per SOP	Determine Linear Calibration range at initial calibration and verify at least every 6 months using a blank and 3 standards; r > 0.995; CCB, CCV every 10 samples	Linearity check must be within ± 10% of original values; ICV, CCV ± 10% of true value	Inspect system, correct problem, rerun calibration and affected samples	Analyst	C-10
Ion Selective Electrode (TKN)	Initial and continuing calibration per SOP	Calibrate daily, ICV, CCV and CCB every 10 samples	ICV, CCV ± 10% of true value; CCB <QL	Inspect system, correct problem, rerun calibration and affected samples	Analyst	C-12
UV-VIS (Phosphorus)	Initial and continuing calibration per SOP	External calibration prior to each use; r ≥ 0.995; CCB, CCV every 10 samples	ICV, CCV ± 10% of true value; CCB <QL	Inspect system, correct problem, rerun calibration and affected samples	Analyst	C-11

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference[a]
TOC Analyzer	Initial and continuing calibration per SOP	CCV each batch	ICAL linearity $r^2 \geq 0.995$ ICV +/- 10% true value CCV+/- 10% true value.	Inspect system, correct problem, rerun calibration and affected samples	Analyst	C-13, C-16
Analytical Balance (TDS, SSC)	Daily	Weigh and record National Institute of Standards and Technology (NIST) traceable standard weights in range of interest	$\pm$ 5% of certified weight	Inspect system, correct problem, recalibrate	Analyst	C-17, C19

[a] Refer to the Analytical SOP References table (Worksheet #23). All SOPs are contained in Appendix C.

QAPP Worksheet #25 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference[a]
GC/MS (VOC and SVOC)	Clean sources and quadrupole rods; maintain vacuum pumps; tune mass spectrometer as needed	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year; other maintenance as needed	See SOP	See SOP	Analyst or Section Supervisor	C-1, T-2
HRGC/LRMS-SIM (PAH and Alkyl PAHs)	Clean sources and quadrupole rods; maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps once per year; other maintenance as needed	See SOP	See SOP	Analyst or Section Supervisor	T-4
HRGC/HRMS (OC Pesticides)	Clean sources and quadrupole rods; maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year; other maintenance as needed	See SOP	See SOP	Analyst or Section Supervisor	T-11
HRGC/HRMS (PCB Congeners and Homologs)	Clean sources; maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps once per year; other maintenance as needed	See SOP	See SOP	Analyst or Section Supervisor	T-6
Isotope Dilution Mass Spectrometry (PCDD/PCDFs)	Clean sources and quadrupole rods; maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year; other maintenance as needed	See SOP	See SOP	Analyst or Section Supervisor	A-1

QAPP Worksheet #25 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference[a]
ICP/AES (Metals)	Replace disposables, flush lines	Cu/Mn ratio	Check connections	Daily or as needed	See SOP	See SOP	Analyst or Section Supervisor	C-4
ICP/MS (Metals)	Replace disposables, flush lines	Cu/Mn ratio	Check connections	Daily or as needed	See SOP	See SOP	Analyst or Section Supervisor	C-5
CVAFS (Mercury, Methyl Mercury)	Replace disposables, flush lines	Sensitivity check	Check connections	Daily or as needed	See SOP	See SOP	Analyst or Section Supervisor	B-1, B-2
IC (Hexavalent Chromium, Sulfate, Chloride)	Replace columns as needed; check eluent and regenerant reservoirs; maintain system pressure	Analytical standards	Instrument performance and sensitivity	Daily or as needed	See SOP	See SOP	Analyst or Section Supervisor	C-15, C-21
GC/FPD (Butyltins)	Change septa, clean injectors, change or trim columns, install new liners; replace purifier as needed; clean autosampler periodically	Detector signals and chromatogram review	Instrument performance and sensitivity	Daily or as needed	See SOP	See SOP	Analyst or Section Supervisor	C-8

QAPP Worksheet #25 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference[a]
UV-VIS Spectrophotometer (Sulfides, Chlorophyll)	Verify lamp is working; clean cuvettes free of lint and scratches, calibrate spectrophotometer every 6 months by an outside service	Analytical standards	Instrument performance and sensitivity	Daily or as needed	See SOP	See SOP	Analyst or Section Supervisor	C-14, C-22
Rapid Flow Analyzer Colorimeter (Ammonia-N)	Replace disposables, flush lines	Analytical standards	Check connections	Daily or as needed	See SOP	See SOP	Analyst or Section Supervisor	C-9
Automated Ion Analyzer (Cyanide)	Replace disposables, flush lines	Analytical standards	Check connections	Daily or as needed	See SOP	See SOP	Analyst or Section Supervisor	C-10
Ion Selective Electrode (TKN)	Replace membrane and filling solution; store electrode in ammonia solution	Verify standardization with solutions as required in SOP	Inspect membrane for signs of failure	Daily or as needed	See SOP	See SOP	Analyst or Section Supervisor	C-12
UV-VIS (Phosphorus)	Verify lamp is working	Analytical standards	Instrument performance and sensitivity	Daily or as needed	See SOP	See SOP	Analyst or Section Supervisor	C-11
TOC Analyzer (TOC, DOC, POC)	Replace disposables, clean quartz boat; oven thermometer calibration quarterly	Analytical standards	Check connections	Daily or as needed	See SOP	See SOP	Analyst or Section Supervisor	C-13, C-16

QAPP Worksheet #25 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference[a]
Analytical Balance (TDS, SSC)	Clean balance after each use; service annually	NIST Traceable weights	Instrument performance	Daily or as needed	Measured weight within certified tolerance	Clean, verify zero on balance, reweigh; call for service	Analyst or Section Supervisor	C-17, C-19
Microscope (protozoan analysis)	Adjustment and testing of illumination plus optics	Optics testing per method	Optics testing per method	Daily or as needed	See SOP	See SOP	Analyst or Section Supervisor	S-1

[a] Refer to the Analytical SOP References table (Worksheet #23). All SOPs are contained in Appendix C

QAPP Worksheet #26 (UFP-QAPP Manual Appendix A) Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): AECOM Field Team (see Worksheet #21 for a list of the sample collection methods)
Sample Packaging (Personnel/Organization): AECOM Field Team
Coordination of Shipment (Personnel/Organization): AECOM Field Team
Type of Shipment/Carrier: UPS or FedEx for overnight delivery or laboratory courier
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Assigned laboratory personnel (see Worksheet #30 for laboratories providing analytical services)
Sample Custody and Storage (Personnel/Organization): Assigned laboratory personnel (see Worksheet #30 for laboratories providing analytical services)
Sample Preparation (Personnel/Organization): Assigned laboratory personnel (see Worksheet #30 for laboratories providing analytical services)
Sample Determinative Analysis (Personnel/Organization): Assigned laboratory personnel (see Worksheet #30 for laboratories providing analytical services)
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Samples will not be stored in the field but will be shipped to the designated laboratory the same day as collection or no later than the day after collection. If circumstances require that the samples be stored in the field, they will be maintained under the method-specified conditions and preserved according to the requirements of Worksheet#19 (e.g., kept at 4±2° C).
Sample Extract/Digestate Storage (No. of days from extraction/digestion): Sample extraction and digestion holding times are summarized in Worksheet #19.
Biological Sample Storage (No. of days from sample collection): Sample storage times for biological tests are summarized in Worksheet #19.
SAMPLE DISPOSAL
Personnel/Organization: Assigned laboratory personnel (see Worksheet #30 for laboratories providing analytical services).
Number of Days from Analysis: Varies by laboratory; laboratory is required to give AECOM 30 days notice prior to intent to discard any project samples.

QAPP Worksheet #26 (UFP-QAPP Manual Appendix A) Sample Handling System

Sample Handling and Custody

Sample custody procedures ensure the timely, correct, and complete analysis of each sample for all parameters requested. A sample is considered to be in someone's custody if it:

- Is in his/her possession
- Is in his/her view, after being in his/her possession
- Is in his/her possession and has been placed in a secured location
- Is in a designated secure area

Sample custody documentation provides a written record of sample collection and analysis. The sample custody procedures require the specific identification of samples associated with an exact location and the recording of pertinent information associated with the sample, including time of collection and any preservation techniques, and a chain of custody (COC) record that serves as physical evidence of sample custody. Custody procedures will be similar to the procedures outlined in USACE's *Requirements for the Preparation of Sampling and Analysis Plans* (USACE 2001) and the USEPA's *Contract Laboratory Program Guidance for Field Samplers* (USEPA 2007b). The COC documentation system provides the means to individually identify, track, and monitor each sample from the time of collection through final data reporting. Sample custody procedures are developed for three areas: sample collection, laboratory analysis, and final evidence files, which are described in Worksheet #27 and SOP LPR-G-05 (Appendix B).

Field Sample Handling and Custody

Field records provide a means of recording information for each field activity performed at the site. COC procedures document pertinent sampling data and all transfers of custody until the samples reach the analytical laboratory. The sample packaging and shipment procedures summarized in Worksheet #27 are designed to ensure that the samples arrive at the laboratory with the COC intact. Specific preservation procedures required for each analytical method are described in Worksheet #19.

QAPP Worksheet #27 (UFP-QAPP Manual Section 3.3.3) Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): The field sample custody procedures including sample packing, shipment, and delivery requirements, are discussed in Worksheet #26. Sample management information is also provided in SOPs LPR-G-05 and LPR-G-06 (Appendix B).

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): Each laboratory has a sample custodian who accepts custody of the samples and verifies that the information on the sample labels matches the information on the COC. The sample custodian will document any discrepancies, document sample condition upon receipt at the laboratory and will sign and date all appropriate receiving documents. Additional information on laboratory sample receiving procedures is provided in the text below this summary table.

Sample Identification Procedures: Each sample will be assigned a unique sample identification number using the Lower Passaic River Data Management System. This identification nomenclature will consist of an alphanumeric code that identifies the program, sample location (including depth interval if needed), and sample type. Details of sample identification are provided below.

Chain-of-Custody Procedures: A COC will accompany all samples from the time of sampling through all custody transfers. Examples of the COC forms are provided in SOP LPR-G-05 (Appendix B); the COC procedures are summarized below and in SOP LPR-G-05.

Sample Identification

Samples will be uniquely identified at the time of collection. The sample identifiers will be assigned according to the following pattern:

Program-Event-Station-Depth-Type

Where:

Program	Two-digit year plus sequence letter to distinguish sampling programs: “11A” for the first event of the CWCM program, assuming an August 2011 event.
Event	“CE” plus two-digit sequence number: Event will define tide stage or hydrographic period for the sample. It is not linked directly to a survey but a range of event numbers will all belong to one survey (e.g., CE01 may be high slack, CE02 may be low slack, and CE03 may non-tidal during a survey). For Routine Events, a specific event code will be linked to each tidal phase as follows: CE01 – low slack tide, CE02 – flood tide, CE03 – high slack tide, and CE04 – ebb tide. For the High Flow sampling event, the samples that are hydrograph dependent will be assigned sequential event codes, starting with CE11 for the samples collected on the rising limb. The sample collected at the peak of the hydrograph will be CE20, and the samples collected during the falling limb will begin with CE21.
Station	“T” plus three-digit representation of RM by tenths” “T014” for station at RM 1.4

QAPP Worksheet #27 (UFP-QAPP Manual Section 3.3.3) Sample Custody Requirements

Depth	Single character sequence letter for depth interval, with "X" reserved to indicate no depth interval: "A" for first (uppermost) depth interval, "B" for lower depth
Type	Single character for sample type: "S" for normal sample, "T" for field duplicate, "R" for equipment rinsate blank

Note: Total and dissolved samples will be assigned the same ID, but will be differentiated by a "Filtered" designation as part of the analysis description on the container label. The designation of "total" and "dissolved" fractions will be carried through the hard copy report and EDD reporting process.

For example:

- A sample labeled 11A-CE01-T102-AS identifies a CWCM program (11A) sample. The sample was collected during the first sampling event for the CWCM program (CE01) and was collected at RM 10.2. The sample is from the uppermost depth (A) and is identified as a normal sample (S).
- A sample labeled 11A-CE04-T014-BG identifies a CWCM program (11A) sample. The sample was collected during the fourth sampling event for the CWCM program (CE04) and was collected at RM 1.4. The sample is from the lower depth (B) and is identified as a field filtered duplicate sample (G).
- A sample labeled 11A-CE01-T014-XR identifies a CWCM program (11A) sample. The sample was collected during the first sampling event for the CWCM program (CE01) and was collected in conjunction with sampling at RM 1.4. The sample is an equipment blank (XR). Note that although equipment rinsate blanks are assigned an ID related to a sample recently processed or collected, this is for identification purposes only. Equipment rinsate blanks are collected periodically and are considered reflective of decontamination procedures for the period (refer to Worksheet #20). They are therefore applicable to all samples collected during that period of the survey using a particular type of equipment.

Electronic Sensor Data File Naming

The unique naming of sensor data storage and/or configuration files will be assigned similar to the scheme for sample identification. YSI files will be named, at a minimum, with the program, event, and station codes (e.g., 10D-E04-T020) plus the specific collection software-assigned file extension. If more than one file is generated per event at one station, then a sequence character will be included (e.g., 10D-E04-T020-B).

Chain of Custody Procedure

The COC form serves as an official communication to the laboratory detailing the specific analyses required for each sample. The COC record is prepared by the field sample custodian and accompanies samples from the time of sampling through all transfers of custody. The COC will be

QAPP Worksheet #27 (UFP-QAPP Manual Section 3.3.3) Sample Custody Requirements

Transfer of Custody and Shipment

Sample custody must be maintained from the time of sampling through shipment and receipt at the laboratory. The procedures for custody transfer are outlined in SOP LPR-G-05 (included in Appendix B).

Sample Packaging and Shipping Requirements

Sample custody must be maintained through shipment of samples to the contracted laboratory. All samples will be packaged and shipped at the end of each day unless other arrangements have been made with the laboratory. Samples will be delivered directly to the laboratory by sampling personnel or will be shipped using the procedures outlined in SOP LPR-G-06 (Appendix B).

Laboratory Custody Procedures

Each contracted laboratory will have a SOP that details the procedures used to document sample receipt and custody within the laboratory. The following procedures must be addressed in the laboratory custody SOP:

- Each laboratory must have a designated sample custodian who accepts custody of the samples at the time of delivery to the laboratory and verifies that the information on the sample labels matches the information on the COC. The sample custodian must sign and date all appropriate receiving documents and note any discrepancies in sample documentation as well as the condition of the samples at the time of receipt.
- Once the samples have been accepted by the laboratory, checked, and logged in, they must be maintained in accordance with laboratory custody and security requirements as outlined in the laboratory QMP.
- To ensure traceability of samples during the analytical process the laboratory will assign a sample ID number based on procedures outlined in the laboratory QMP or laboratory SOP.
- The following procedures, at a minimum, must be documented by the laboratory:
  - Sample extraction /preparation
  - Sample analysis
  - Sample disposal
  - Data reduction
  - Data reporting

QAPP Worksheet #27 (UFP-QAPP Manual Section 3.3.3) Sample Custody Requirements

- Laboratory personnel are responsible for sample custody until the samples are returned to the sample custodian.
- When sample analysis and QC procedures are completed, any remaining sample must be stored in accordance with contractual terms. A minimum of 30 days notice must be provided before disposal of any sample. Data sheets, custody documents and all other laboratory records must be retained in accordance with contractual agreements.

Final Evidence Files

Laboratory records including COCs and other sample receiving records, sample preparation and analysis records, and the final data package become part of the laboratory final evidence file and must be retained as required by the contractual agreement. An original copy of the data package and associated electronic deliverable must be provided to AECOM in accordance with the contractual agreement and will be retained by AECOM along with associated field records and other related correspondence.

Final evidence files as retained by AECOM will include, but not be limited to, correspondence (paper and email), plans, contractual documents, maps and drawings, field data, calculations, assessment reports, laboratory deliverables, progress and data reports. This information will be maintained in a secure area according to the procedures outlined in the Lower Passaic River QMP (AECOM 2009). Electronic files will be archived by ddms.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix Water
Analytical Group[a] VOCs
Concentration Level Low
Sampling SOP[b] LPR-FI-04
Analytical Method/ SOP Reference[c] C-1, C-2
Sampler's Name AECOM Field Staff
Field Sampling Organization AECOM
Analytical Organization CAS (Kelso)
Number of Sample Locations All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB/Instrument Blank	1/Prep Batch (≤20 samples)	No target compounds >QL; no common lab contaminants >5x QL.	If sufficient sample is available, reanalyze samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No target ompounds >QL; no common lab contaminants >5x QL.
Equipment Rinsate Blank	1 per event per sampling team	No target compounds >QL; no common lab contaminants >5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Accuracy/Bias-Contamination	No target compounds >QL; no common lab contaminants >5x QL
Trip Blank	1 per cooler of VOC samples	No target compounds >QL; no common lab contaminants >5x QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Accuracy/Bias-Contamination	No target compounds >QL; no common lab contaminants >5x QL
Surrogates	Every sample	1,2-Dichloroethane-d4: 59-127%R 4-Bromofluorobenzene: 68-117%R Dibromofluoromethane: 73-122%R Toluene-d8: 78-129%R	Check calculations and instrument performance; recalculate, reanalyze	Analyst/Section Supervisor	Accuracy/Bias	1,2-Dichloroethane-d4: 59-127%R 4-Bromofluorobenzene: 68-117%R Dibromofluoromethane: 73-122%R Toluene-d8: 78-129%R

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
LCS	1/Prep Batch (≤20 samples)	Compound-specific %Rs; see Appendix C-2	If sufficient sample is available, reanalyze samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	Compound-specific %Rs; see Appendix C-2
MS	1/Prep Batch (≤20 samples)	Compound-specific %Rs; see Appendix C-2	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	Compound-specific %Rs; see Appendix C-2
MSD	1/Prep Batch (≤20 samples)	Compound-specific RPDs; see Appendix C-2	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Precision	Compound-specific RPDs; see Appendix C-2
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	5	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	SVOCs
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	T-2, T-7
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	TestAmerica (Pittsburgh)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Prep Batch (≤20 samples)	No target compounds >QL; no common lab contaminants >5x QL.	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >20x blank result or sample results not detected (ND).	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No target compounds >QL; no common lab contaminants >5x QL.
Instrument Blank	Once per 12 hours if MB is not run	No target compounds >QL	Reanalyze affected samples. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No target compounds >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compounds >QL; no common lab contaminants >5x QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Accuracy/Bias-Contamination	No target compounds >QL; no common lab contaminants >5x QL

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Surrogates	Every sample	2-Fluorobiphenyl: 19-107%R 2-Fluorophenol: 10-111%R 2,4,6-Tribromophenol: 16-122%R Nitrobenzene-d5: 23-112%R Phenol-d5: 15-112%R Terphenyl-d14: 10-132%R	Check calculations and instrument performance; recalculate, reanalyze	Analyst/Section Supervisor	Accuracy/Bias	2-Fluorobiphenyl: 19-107%R 2-Fluorophenol: 10-111%R 2,4,6-Tribromophenol: 16-122%R Nitrobenzene-d5: 23-112%R Phenol-d5: 15-112%R Terphenyl-d14: 10-132%R
LCS	1/Prep Batch (≤20 samples)	Compound-specific %Rs; see Appendix C-2	If sufficient sample is available, reanalyze samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	Compound-specific %Rs; see Appendix C-2
MS	1/Prep Batch (≤20 samples)	Compound-specific %Rs; see Appendix C-2	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	Compound-specific %Rs; see Appendix C-2
MSD	1/Prep Batch (≤20 samples)	Compound-specific RPDs; see Appendix C-2	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Precision	Compound-specific RPDs; see Appendix C-2
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	5	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	PAHs and Alkyl PAHs (LRMS-SIM)
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	T-4, T-3
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	TestAmerica (Knoxville)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Prep Batch (≤20 samples)	No target compounds >QL.	If sufficient sample is available, reanalyze samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No target compounds >QL.
Instrument Blank	Once per 12 hours if MB is not run	No target compounds >QL	Reanalyze affected samples. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No target compounds >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compounds >QL.	Evaluate during data validation. Qualify data as needed.	Data Validator	Accuracy/Bias-Contamination	No target compounds >QL
Labeled Compounds	Every sample	60-140%R in MB & LCS 30-120%R in field samples	Check calculations. Ensure that instrument performance is acceptable. If signal/noise (S/N) ratio <10, reprepare and reanalyze sample. If S/N ratio >10, flag data	Analyst/Section Supervisor	Accuracy/Bias	60-140%R in MB & LCS 30-120%R in field samples
LCS	1/Prep Batch (≤20 samples)	60-140%R	If sufficient sample is available, reanalyze samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	60-140%R

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MS	1/20 field samples	60-140%R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	60-140%R
MSD	1/20 field samples	RPD<30%	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Precision	RPD<30%
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	5	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	OC Pesticides
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	T-11
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	TestAmerica (West Sacramento)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Prep Batch (≤20 samples)	No target compounds >QL.	1) Report results if sample results >10x blank result or sample results ND. 2) If results are <20x blank and if sufficient sample is available, re-extract and reanalyze samples. 3) If insufficient sample is available, reanalyze extracts. 4) Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No target compounds >QL.
Instrument Blank	Once per 12 hours if MB is not run	No target compounds >QL	Reanalyze affected samples. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No target compounds >QL.
Equipment Rinsate Blank	1 per event per sampling team	No target compounds >QL.	Evaluate during data validation. Qualify data as needed.	Data Validator	Accuracy/Bias-Contamination	No target compounds >QL.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
OPR Sample (equivalent to LCS)	1/Prep Batch (<20 samples)	50-120%R, except for 4,4'-DDD 24-123%; 2,4'-DDE 24-123%; Endrin Aldehyde 50-170%; Endrin Ketone 50-134%	1) Check calculations. 2) Reanalyze LCS. Repeated reanalysis is acceptable if the failure is attributed to instrument variability. 3) If repeated failures occur on consecutive LCSs for the same analyte, the cause of the failure will be investigated and corrected before any re-extraction is performed. 4) If sufficient sample is available, re-extract and reanalyze samples. 5) If insufficient sample is available, reanalyze extracts. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	50-120%R, except for 4,4'-DDD 24-123%; 2,4'-DDE 24-123%; Endrin Aldehyde 50-170%; Endrin Ketone 50-134%;
MS	1/20 field samples	50-150%R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	50-150%R
MSD	1/20 field samples	RPD<30%	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Precision	RPD<30%

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Labeled Compounds	Spiked into every sample and QC sample	Per EPA 1699 Table 5	Check all calculations for error; ensure that instrument performance is acceptable; recalculate data and/or reanalyze extract if either of above checks reveals a problem. If S/N <10 for quantitation ion, reprepare and reanalyze sample. If S/N>10, flag data.	Analyst/Section Supervisor	Accuracy/Bias	Per EPA 1699 Table 5
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE and QCCS Sample[d]	9	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	PCBs – Congeners and Homologs
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	T-6
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	TestAmerica (Knoxville)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compounds >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compounds >QL
Instrument Blank	Once per 12 hours if MB is not run	No target compounds >QL	Reanalyze affected samples. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No target compounds >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compounds> QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Accuracy/Bias Contamination	No target compounds >QL
OPR Sample (equivalent to LCS)	1/Batch (20 samples)	50-150%R Toxics/LOC congeners; 40-160%R all other congeners	Reanalyze affected samples. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias	50-150%R Toxics/LOC congeners; 40-160%R all other congeners
MS	1/20 field samples	50-150%R Toxics/LOC congeners; 40-160%R all other congeners	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	50-150%R Toxics/LOC congeners; 40-160%R all other congeners
MSD	1/20 field samples	RPD<30%	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Precision	RPD<30%

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Labeled Compounds	Spiked into every sample and QC sample.	30-140%R	Check all calculations for error; ensure that instrument performance is acceptable; recalculate data and/or reanalyze extract if either of above checks reveal problem. If S/N<10 for the quantitation ion, reprepare and reanalyze sample. If S/N>10, flag data.	Analyst/Section Supervisor	Accuracy/Bias	30-140%R
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE and QCCS Sample[d]	9	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	PCDD/PCDFs
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	A-1
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	Analytical Perspectives
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples	No target compounds >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No target compounds >QL
Instrument Blank	Once per 12 hours if MB is not run	No target compounds >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No target compounds >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compounds >QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Accuracy/Bias-Contamination	No target compounds >QL
Labeled Compounds	Spiked into every sample and QC sample.	See reference method and SOP for compound specific control limits	Check all calculations for error; ensure that instrument performance is acceptable; recalculate data and/or reanalyze extract if either of above checks reveal a problem. If S/N<10 for quantitation ion, reprepare and reanalyze sample. If S/N>10, flag data.	Analyst/Section Supervisor	Accuracy/Bias	See reference method and SOP for compound specific control limits

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
BCS_3	1/Batch (20 samples)	%D for RRF vs ICAL ≤ 20% except labeled analogs ≤ 30%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	%D for RRF vs ICAL ≤ 20% except labeled analogs ≤ 30%
MS	1/Batch (20 samples)	50-150%R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	50-150%R
MSD	1/Batch (20 samples)	RPD≤ 25%	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	RPD≤ 25%
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE and QCCS Sample[d]	9	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	Metals (total and dissolved): ICP/AES
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04, LPR-FI-06
Analytical Method/ SOP Reference[c]	C-4, C-3
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS (Kelso)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compounds >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compounds >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compounds >QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Accuracy/Bias Contamination	No target compounds >QL
LCS	1/Batch (20 samples)	Compound-specific %Rs; see Appendix C-2	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	Compound-specific %Rs; see Appendix C-2
Laboratory Duplicate	1/Batch (20 samples)	RPD ≤ 20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤ 20%
MS	1/Batch (20 samples)	Compound-specific %Rs; see Appendix C-2	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	Compound-specific %Rs; see Appendix C-2

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Field Duplicate	1/20 field samples	RPD ≤20% if both samples are >5x QL or absolute difference between concentrations <QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Precision	RPD ≤20% if both samples are >5x QL or absolute difference between concentrations <QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	10 (total only; both freshwater and saltwater matrices)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	Metals (total and dissolved): ICP/MS
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04, LPR-FI-06
Analytical Method/ SOP Reference[c]	C-5, C-3, C-6
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS (Kelso)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compounds >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Contamination	No target compounds >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compounds >QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Accuracy/Bias Contamination	No target compounds >QL
LCS	1/Batch (20 samples)	Compound-specific %Rs; see Appendix C-2	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	Compound-specific %Rs; see Appendix C-2
Laboratory Duplicate	1/Batch (20 samples)	RPD ≤20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤20%
MS	1/Batch (20 samples)	Compound-specific %Rs; see Appendix C-2	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	Compound-specific %Rs; see Appendix C-2

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Field Duplicate	1/20 field samples	RPD ≤20% if both samples are >5x QL or absolute difference between concentrations <QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed.	Data Validator	Precision	RPD ≤20% if both samples are >5x QL or absolute difference between concentrations <QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	10 (total only; both freshwater and saltwater matrices)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	Metals: Mercury (total and dissolved), Low Level
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04, LPR-FI-06
Analytical Method/ SOP Reference[c]	B-1
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	Brooks Rand, LLC
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	3/Batch (20 samples)	Average MB <2x MDL and standard deviation <0.67x MDL or <0.1x the concentration of project samples	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	Average MB <2x MDL and standard deviation <0.67x MDL or <0.1x the concentration of project samples
Equipment Rinsate Blank	1 per event per sampling team	No target compound>QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
LCS	1/batch	80 -120%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	80 -120%R
CRM	1/Batch (10 samples)	Within 25% of certified value	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	Within 25% of certified value
Laboratory Duplicate	1/Batch (10 samples)	RPD $\leq$24%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD $\leq$24%
MS	1/Batch (10 samples)	71-125% R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	71-125% R

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MSD	1/Batch (10 samples)	≤24% RPD	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Precision	≤24% RPD
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	5 (total only)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	Metals: Methyl Mercury (total and dissolved)
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04, LPR-FI-06
Analytical Method/ SOP Reference[c]	B-2
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	Brooks Rand, LLC
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	Minimum of four MBs with each batch (10 samples)	Average MB ≤0.045 ng/L and standard deviation ≤0.015 ng/L or <0.1x the concentration of project samples	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	Average MB ≤0.45 ng/L and standard deviation <0.15 ng/L or <0.1x the concentration of project samples
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
CRM	1/Batch (10 samples)	Within 35% of certified value	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	Within 35% of certified value
Laboratory Duplicate	1/Batch (10 samples)	RPD ≤ 35% (or ±QL if results are ≤5x the QL)	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤ 35% (or ± QL if result is ≤5x the QL)
MS	1/Batch (10 samples)	65-135%R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias-Precision	65-135%R

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MSD	1/Batch (10 samples)	≤35% RPD	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Precision	<24% RPD
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	5 (total only)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	Hexavalent Chromium
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04, LPR-FI-06
Analytical Method/ SOP Reference[c]	C-15
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS (Rochester)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits C	A	Person(s) Responsible for CA D	QI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compound >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Evaluate during data validation. Qualify data as needed	Data Validator	Accuracy/Bias Contamination	No target compound >QL
Field Buffer Blank	1 per event per study area/per buffer lot	No target compound >QL	Evaluate during data validation. Qualify data as needed	Data Validator	Accuracy/Bias Contamination	No target compound >QL
LCS	1/Batch (20 samples)	90-110%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	90-110%R
Laboratory Duplicate	1/Batch (20 samples)	RPD ≤20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤20%
MS	1/Batch (20 samples)	90-110%R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	90-110%R

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MSD	1/Batch (20 samples)	RPD ≤20%	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Precision	RPD ≤20%
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	5 (total only)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	Butyltins
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	C-8, C-7
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS (Kelso)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compounds >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compounds >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compounds >QL	Evaluate during data validation. Qualify data as needed	Data Validator	Accuracy/Bias Contamination	No target compounds >QL
Surrogate	Every sample	Tripropyltin: 24-142%R	Check calculations and instrument performance; recalculate, reanalyze	Analyst/Section Supervisor	Accuracy/Bias	Tripropyltin: 24-142%R
LCS	1/Batch (20 samples)	Monobutyltin: 40-165%R Dibutyltin: 18-128%R Tributyltin: 30-120%R Tetrabutyltin: 24-104%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	Monobutyltin: 40-165%R Dibutyltin: 18-128%R Tributyltin: 30-120%R Tetrabutyltin: 24-104%R

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MS	1/Batch (20 samples)	Monobutyltin: 40-165%R Dibutyltin: 18-128%R Tributyltin: 30-120%R Tetrabutyltin: 24-104%R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	Monobutyltin: 40-165%R Dibutyltin: 18-128%R Tributyltin: 30-120%R Tetrabutyltin: 24-104%R
MSD	1/Batch (20 samples)	RPD ≤30%	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Precision	RPD ≤30%
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	5	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	General Chemistry - Sulfide
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	C-14
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS(Kelso)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compound >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Evaluate during data validation. Qualify data as needed	Data Validator	Accuracy/Bias Contamination	No target compound >QL
LCS	1/Batch (20 samples)	74-122%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	74-122%R
Laboratory Duplicate	1/Batch (20 samples)	RPD ≤20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤20%
MS	1/Batch (20 samples)	74-122%R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	74-122%R

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	0 (review only)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	SSC
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	C-17
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	Xenco (Phoenix)
Number of Sample Locations	Refer to Worksheet #18

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compound >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Evaluate during data validation. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
Laboratory Duplicate	1/Batch (20 samples)	RPD ≤20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤20%
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	General Chemistry – Ammonia -N
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	C-9
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS (Kelso)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compound >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Evaluate during data validation. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
LCS	1/Batch (20 samples)	90-112%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	90-112%R
Laboratory Duplicate	1/Batch (20 samples)	RPD $\leq$ 20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD $\leq$ 20%
MS	1/Batch (20 samples)	90-112%R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	90-112%R

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	0 (review only)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	General Chemistry - Cyanide
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[b]	C-10
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS (Kelso)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compound >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Evaluate during data validation. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
LCS	1/Batch (20 samples)	83-116%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	83-116%R
Laboratory Duplicate	1/Batch (20 samples)	RPD ≤20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤20%
MS	1/Batch (20 samples)	35-144%R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	35-144%R

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Field Duplicate	1/20 field samples	RPD ≤20% if both samples are >5x QL or absolute difference between concentrations <QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤20% if both samples are >5x QL or absolute difference between concentrations <QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	0 (review only)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	General Chemistry - TKN
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	C-12
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS (Kelso)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compound >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Evaluate during data validation. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
LCS	1/Batch (20 samples)	78-117%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	78-117%R
Laboratory Duplicate	1/Batch (20 samples)	RPD ≤20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤20%
MS	1/Batch (20 samples)	37-158%R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	37-158%R

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	0 (review only)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	General Chemistry – Total Phosphorus
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	C-11
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS(Kelso)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compound >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Evaluate during data validation. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
LCS	1/Batch (20 samples)	88 - 113%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	88 - 113%R
Laboratory Duplicate	1/Batch (20 samples)	RPD ≤20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤20%
MS	1/Batch (20 samples)	50 -144%R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	50 -144%R

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	0 (review only)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	General Chemistry – TOC and DOC
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	C-13, C-16
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS-Kelso
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compound>QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	<QL
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Evaluate during data validation. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
LCS	1/Batch (20 samples)	95-105%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	95-105%R
LCSD	1/Batch (20 samples)	RPD ≤20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤20%
Inorganic Carbon Spike	1/Batch (20 samples)	≤110% of the unspiked sample	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	≤110% of the unspiked sample
MS	1/Batch (20 samples)	80-120%R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	80-120%R
MSD	1/Batch (20 samples)	RPD ≤20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤20%

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	0 (review only)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	General Chemistry - POC
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	C-16
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS (Tucson)
Number of Sample Locations	Refer to Worksheet #18

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (10 samples)	<0.025 mg/L or <10% of the concentration in the associated samples	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	<0.025 mg/L or <10% of the concentration in the associated samples
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Evaluate during data validation. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
LCS	1 per 10 samples	95-105%R or within the manufacturer's control limits if >95-105%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	95-105%R or within the manufacturer's control limits if >95-105%R
LFB	1 per 10 samples	85-115%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	85-115%R
Laboratory Duplicate	1 per 10 samples	RPD ≤20% if both samples >10x QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤20% if both samples >10x QL

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	General Chemistry – Alkalinity
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	C-20
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS (Kelso)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compound >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Evaluate during data validation. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
LCS	1/Batch (20 samples)	94-106%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	94-106%R
Laboratory Duplicate	1/Batch (20 samples)	RPD ≤20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤20%
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
PE Sample[d]	0 (review only)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	General Chemistry – Chlorophyll a
Concentration Level[b]	Low
Sampling SOP	LPR-FI-04
Analytical Method/ SOP Reference[c]	C-22
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS (Kelso)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compound >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
Filtration Blank	1 prior to the start of sample filtration and 1 at the conclusion of sample filtration	No target compound >QL	Eliminate source of contamination. Refilter and reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Evaluate during data validation. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
LCS	1/Batch (20 samples)	91-108%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	91-108%R
Laboratory Duplicate	1/Batch (20 samples)	RPD ≤20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤20%
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
		QL if sample and/or field duplicate are ≤5x QL				QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	1	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	Sulfate and Chloride
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	C-21
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS (Kelso)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compound >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Evaluate during data validation. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
LCS	1/Batch (20 samples)	90-110%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	90-110%R
Laboratory Duplicate	1/Batch (20 samples)	RPD ≤20%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤20%
MS	1/Batch (20 samples)	80-120%R	Flag data. Discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias	80-120%R

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
PE Sample[d]	0 (review only)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	General Chemistry – TDS
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	C-19
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	CAS (Kelso)
Number of Sample Locations	All locations

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No target compound >QL	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
Equipment Rinsate Blank	1 per event per sampling team	No target compound >QL	Evaluate during data validation. Qualify data as needed	Analyst/Section Supervisor	Accuracy/Bias Contamination	No target compound >QL
LCS	1/Batch (20 samples)	85-115%R	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	85-115%R
Laboratory Duplicate	1/Batch (20 samples)	RPD ≤10%	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Precision	RPD ≤10%
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
PE Sample[d]	0 (review only)	Supplier Certified Limits	Feedback to laboratory; laboratory evaluation and response	AECOM Project Chemist/ Laboratory Staff	Accuracy/Bias	Supplier Certified Limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	Bacteria – Fecal streptococci and fecal enterococci
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	E-3, E-4
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	EMSL, Inc.
Number of Sample Locations	5 (Minimum, see Worksheet #20)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1 per batch of 20 samples	No pink-red colored colonies	Reanalyze associated samples, dependent upon extent of holding time exceedance	Analyst/Section Supervisor	Accuracy/Bias Contamination	No pink-red colored colonies
Control Sample	1 per batch of 20 samples	Pink-red colored colonies	Reanalyze associated sample, dependent upon extent of holding time exceedance	Analyst/ Section Supervisor	Accuracy/Bias	Pink-red colored colonies
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	Bacteria –Total coliform and *E. coli*
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	E-1
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	EMSL, Inc.
Number of Sample Locations	5 (Minimum, see Worksheet #20)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1 per batch of 20 samples	No color, no fluorescence	Reanalyze associated samples, dependent upon extent of holding time exceedance	Analyst/Section Supervisor	Accuracy/Bias Contamination	No color, no fluorescence
Control Sample	1 per batch of 20 samples	Yellow color (coliform) with fluorescence (*E.coli*)	Reanalyze associated sample, dependent upon extent of holding time exceedance	Analyst/ Section Supervisor	Accuracy/Bias	Yellow color (coliform) with fluorescence (*E.coli*)
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	Bacteria – Fecal coliform
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	E-2
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	EMSL, Inc.
Number of Sample Locations	5 (Minimum, see Worksheet #20)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1 per batch of 20 samples	No blue colored colonies	Reanalyze associated samples, dependent upon extent of holding time exceedance	Analyst/Section Supervisor	Accuracy/Bias Contamination	No blue colored colonies
Control Sample	1 per batch of 20 samples	Blue colored colonies	Reanalyze associated sample, dependent upon extent of holding time exceedance	Analyst/Section Supervisor	Accuracy/Bias	Blue colored colonies
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23
[d] Refer to Worksheet #31 for additional details of the PE program.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	Water
Analytical Group[a]	Protozoans - Cryptosporidium and *Giardia*
Concentration Level	Low
Sampling SOP[b]	LPR-FI-04
Analytical Method/ SOP Reference[c]	S-1
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	ASI
Number of Sample Locations	5 (Minimum, see Worksheet #20)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1 per batch of 20 samples	No detected oocysts or cysts	Reanalyze associated samples, dependent upon extent of holding time exceedance	Analyst/Section Supervisor	Accuracy/Bias Contamination	No detected oocysts or cysts
Control Sample	1 per batch of 20 samples	*Giardia* (14-100%R) Cryptosporidium (11-100%R)	Reanalyze associated sample, dependent upon extent of holding time exceedance	Analyst/ Section Supervisor	Accuracy/Bias	See SOP control limits
Field Duplicate	1/20 field samples	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL	Evaluate during data validation. Qualify data as needed	Data Validator	Precision	RPD ≤30% if both samples are >5x QL or absolute difference between concentrations <2x QL if sample and/or field duplicate are ≤5x QL
MS	1/10 field samples	*Giardia* (14-118%R) Cryptosporidium (13-111%R)	Evaluate during data validation. Qualify data as needed	Data Validator	Accuracy/Bias	See SOP control limits

[a] Refer to QAPP Worksheet #15 for a complete list of analytes for each analytical group
[b] Refer to QAPP Worksheet #21
[c] Refer to QAPP Worksheet #23

QAPP Worksheet #29 (UFP-QAPP Manual Section 3.5.1) Project Documents and Records Table

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
Field notes, field data sheets, field logbooks	Field notes, field data sheets, field logbooks	Custody records and copies of airbills	Field TSA reports	Progress reports
Custody records and airbills	Field instrument calibration records	Analytical data packages and EDDs	AECOM assessment of external laboratory audit findings	Final report - Prepared and submitted to clients and USEPA.
Communication logs, records or copies of pertinent e-mails	Field measurement data	Communication logs	DVRs	
QAPP/FSP Addendum and HASP	QAPP/FSP Addendum and HASP	Laboratory notebooks and bench sheets documenting sample preparation and analysis	QA reports to management	
Corrective action (CA) reports and results	CA reports and results	Instrument maintenance and calibration records, standard preparation and traceability records	CA reports and results	
Documentation of field modifications	Documentation of field modifications	Laboratory SOPs and documentation of method modifications	Internal laboratory assessments, including internal audits, third-party audit reports, and PE results	
Daily Activity Log	Daily Activity Log	CA logs and documentation of CA results	AECOM assessment PE sample results	

This section describes the project data management process tracing the data from their generation through final use and/or storage. All project data, communications, and other information must be documented in a format useable to project personnel.

Project Document Control System

Project documents are controlled by AECOM's Project Document Control Manager who will maintain and manage hardcopies and electronic copies of all project related documents according to the Lower Passaic River QMP (AECOM 2009). Electronic copies of all information relating to this project are maintained on the project network files, which are backed up at least once per day; access to these files is limited to authorized project personnel. All project data and information must be documented in a standard format that is usable by all project personnel.

QAPP Worksheet #29 (UFP-QAPP Manual Section 3.5.1) Project Documents and Records Table

Data Recording

Data generated during this project will be captured electronically or entered by hand into bound field or laboratory logbooks or preprinted forms (refer to SOP LPR-G-01 in Appendix B). Computer generated laboratory data will be managed using the laboratory information management system (LIMS); the LIMS used by subcontracted laboratories are described in their QA documentation.

Data Quality Assurance Procedures

AECOM will monitor the progress of sample collection to verify that samples are collected as planned. The progress of sample collection and processing will be monitored through the documentation of samples collected and shipped each day. The participating laboratories must maintain a formal QMP to which they adhere and which addresses all data generating aspects of daily operations. A policy of continuous improvement will allow all data generation processes to be reviewed and modified as needed to meet project objectives. Periodic audits of field and laboratory operations will ensure that data collection, documentation and QC procedures are being followed.

Laboratory Data Transmittal

Laboratory data are managed by the laboratory's LIMS beginning with the sample receiving process. Laboratories are required to provide validated data reports (sample results, QC summary information, and supporting raw data) including EDDs within the turnaround times specified in Worksheet #30. EDDs will be provided in an Earthsoft EQuIS® four-file format (modified by AECOM), using reference file tables provided by AECOM. All EDDs will be checked prior to transmittal to AECOM using current versions of Earthsoft's Electronic Data Processor (EDP).

Data Storage and Retrieval

Completed forms, logbooks, photographs, data packages, and electronic files will be transmitted regularly to the AECOM Project Document Control Manager. Each laboratory will maintain copies of all documents it generates as well as backup files of all electronic data relating to the analysis of samples. Raw data and electronic files of all field samples, QC analyses and blanks must be archived from the date of generation and maintained by each laboratory in accordance with the terms of the contract between AECOM and the laboratory. Project closeout will be conducted in accordance with contractual guidance. As required by the Settlement Agreement all data and other project records will be made available to USEPA.

Data transfer to USEPA will include a Multimedia Electronic Data Deliverable (MEDD) that conforms to USEPA Region 2 MEDD format (http://www.epa.gov/region02/superfund/medd.htm). The MEDD will include all qualified and rejected data (including the reported, numerical value for rejected data per the request of USEPA). Laboratory data packages and DVRs will also be transmitted to USEPA monthly.

QAPP Worksheet #30 (UFP-QAPP Manual Section 3.5.2.3) Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ ID Number	Analytical SOP	Data Package Turnaround Time[a]	Laboratory/ Organization	Backup Laboratory/ Organization)[b]
Water	VOCs	Low	All	C-1	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	TestAmerica 5815 Middlebrook Pike Knoxville, TN 37921 John Reynolds 865.291.3000
Water	SVOCs	Low	All	T-2	30 days	Test America 301 Alpha Drive Pittsburgh, PA 15238 Chris Kovitch 412.963.7058	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222
Water	PAHs –LRMS SIM	Low	All	T-4	45 days	TestAmerica 5815 Middlebrook Pike Knoxville, TN 37921 John Reynolds 865.291.3000	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222
Water	OC Pesticides	Low	All	T-11	45 days	TestAmerica 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker 916.374.4334	Vista Analytical Laboratory 1104 WIndfield Way El Dorado Hills, CA 95762 Martha Maier 916.673.1520
Water	PCBs (Homologs and Congeners)	Low	All	T-6	45 days	TestAmerica 5815 Middlebrook Pike Knoxville, TN 37921 John Reynolds 865.291.3000	Analytical Perspectives 2714 Exchange Drive Wilmington, NC 28405 Todd Vilen 910-794-1613
Water	PCDD/PCDFs	Low	All	A-1	45 days	Analytical Perspectives 2714 Exchange Drive Wilmington, NC 28405 Todd Vilen 910-794-1613	TestAmerica 880 Riverside Parkway West Sacramento, CA 95605 David Alltucker 916.374.4334

QAPP Worksheet #30 (UFP-QAPP Manual Section 3.5.2.3) Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ ID Number	Analytical SOP	Data Package Turnaround Time[a]	Laboratory/ Organization	Backup Laboratory/ Organization)[b]
Water	TAL Metals (excluding mercury) and Titanium (total and dissolved), hardness (by calculation)	Low	All	C-4, C-5	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	Brooks Rand, LLC 3958 6th Ave. NW Seattle, WA 98107 Misty Kennard-Mayer 206-632-6206
Water	Low Level Mercury (total and dissolved)	Low	All	B-1	30 days	Brooks Rand, LLC 3958 6th Ave. NW Seattle, WA 98107 Misty Kennard-Mayer 206-632-6206	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222
Water	Methyl Mercury (total and dissolved)	Low	All	B-2	30 days	Brooks Rand, LLC 3958 6th Ave. NW Seattle, WA 98107 Misty Kennard-Mayer 206-632-6206	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222
Water	Hexavalent Chromium	Low	All	C-15	30 Days	CAS 1 Mustard St. Suite 250 Rochester, NY 14609 Janice Jaeger 585.288.5380	NA
Water	Butyltins	Low	All	C-8	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	TestAmerica 30 Community Drive, Suite 11 South Burlington, VT 05403 Kris Dusablon 865.291.3000
Water	Sulfate and Chloride	Low	All	C-21	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	TestAmerica 301 Alpha Drive RIDC Park Pittsburgh, PA 15238 Chris Kovitch 412.963.7058

QAPP Worksheet #30 (UFP-QAPP Manual Section 3.5.2.3) Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ ID Number	Analytical SOP	Data Package Turnaround Time[a]	Laboratory/ Organization	Backup Laboratory/ Organization)[b]
Water	Ammonia-N	Low	All	C-9	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	TestAmerica 301 Alpha Drive RIDC Park Pittsburgh, PA 15238 Chris Kovitch 412.963.7058
Water	Cyanide	Low	All	C-10	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	TestAmerica 301 Alpha Drive RIDC Park Pittsburgh, PA 15238 Chris Kovitch 412.963.7058
Water	TKN	Low	All	C-12	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	TestAmerica 4101 Shuffel Dr. NW North Canton, OH 44720 Ken Kuzior 330.497.9396
Water	Total Phosphorus	Low	All	C-11	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	TestAmerica 4101 Shuffel Dr. NW North Canton, OH 44720 Ken Kuzior 330.497.9396
Water	TOC/DOC	Low	All	C-13	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	TestAmerica 301 Alpha Drive RIDC Park Pittsburgh, PA 15238 Chris Kovitch 412.963.7058
Water	POC	Low	All	C-16	30 days	CAS 3860 S. Palo Verde Road, Suite 302 Tucson, AZ 85714 Todd Poyfair 602.443.7019	TestAmerica 301 Alpha Drive Pittsburgh, PA 15238 Chris Kovitch 412.963.7058

QAPP Worksheet #30 (UFP-QAPP Manual Section 3.5.2.3) Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ ID Number	Analytical SOP	Data Package Turnaround Time[a]	Laboratory/ Organization	Backup Laboratory/ Organization)[b]
Water	Total Sulfide	Low	All	C-14	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	Test America 301 Alpha Drive Pittsburgh, PA 15238 Chris Kovitch 412.963.7058
Water	TDS	Low	All	C-19	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	Test America 301 Alpha Drive Pittsburgh, PA 15238 Chris Kovitch 412.963.7058
Water	Alkalinity	Low	All	C-20	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	Test America 301 Alpha Drive Pittsburgh, PA 15238 Chris Kovitch 412.963.7058
Water	SSC	Low	All	C-17	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	Test America 30 Community Drive, Suite 11 South Burlington, VT 05403 Kris Dusablon 865.291.3000
Water	Chlorophyll a	Low	All	C-22	30 days	CAS 1317 South 13th Ave. Kelso, WA 98626 Ed Wallace 360.577.7222	NA
Water	Bacteria	Low	See Worksheet #18	E-1, E-2, E-3, E-4	30 days	EMSL, Inc. 200 Route 130 N. Cinnaminson, NJ 08077 Jason Dobranic 800-220-3675	NA

QAPP Worksheet #30 (UFP-QAPP Manual Section 3.5.2.3) Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ ID Number	Analytical SOP	Data Package Turnaround Time[a]	Laboratory/ Organization	Backup Laboratory/ Organization)[b]
Water	Protozoans	Low	See Worksheet #18	S-1	30 days	Analytical Services, Inc. 130 Allen Brook Lane Williston, VT 05495 Paul S. Warden 800.723.4432 x15	NA

[a] Turnaround time is in calendar days from receipt of the last sample in the data package sample delivery group per sampling event.

[b] The backup laboratory will only be used if the primary laboratory is unable to analyze the samples or if serious QC issues with the primary laboratory occur. Prior to use of a backup laboratory, the laboratory's SOPs, detection limits, and PE data will be assessed to minimize inter-laboratory variability. Any change in laboratories will be communicated to USEPA prior to the change.

QAPP Worksheet #31 (UFP-QAPP Manual Section 4.1.1) Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing CA	Person(s) Responsible for Monitoring Effectiveness of CA
Safety Audit	Once, during the first week of field work; follow-up audits as necessary	Internal	AECOM	AECOM Regional EHS Manager	AECOM FTM, SSO, and CWCM Task Manager	AECOM FTM, SSO and CWCM Task Manager	AECOM Regional EHS Manager
Field TSA	Once during the first week of field work; follow-up audits as necessary	Internal	AECOM	AECOM Project QA Manager or designee	AECOM FTM and CWCM Task Manager	AECOM FTM and CWCM Task Manager	AECOM Project QA Manager
Laboratory Audits	Per laboratory QMP; at least annually	Internal	Laboratory	Laboratory QA Officer or designee	Laboratory management and staff	Laboratory management and staff	Laboratory QA Officer
	Per certification requirements	External	State or national certifying authority	State or national certifying authority auditor	Laboratory management and staff	Laboratory management and staff	Laboratory QA Officer
Review of External Laboratory Audit Findings	Prior to start of CWCM and periodically as needed	External	AECOM	AECOM Project Chemist, under direction of AECOM QA Manager	Laboratory management and staff	Laboratory management and staff	Laboratory QA Officer AECOM Project Chemist and AECOM Project QA Manager
Non-conformance Reporting	As needed	Internal	AECOM	AECOM Project QA Manager or designee	AECOM FTM and CWCM Task Manager	AECOM FTM and CWCM Task Manager	AECOM Project QA Manager
PE samples	Prior to field work; with first event and up to quarterly as necessary	External	AECOM	AECOM Project Chemist , under direction of AECOM QA Manager	Laboratory management and staff	Laboratory management and staff	Laboratory QA Officer AECOM Project Chemist And AECOM Project QA Manager

QAPP Worksheet #31 (UFP-QAPP Manual Section 4.1.1) Planned Project Assessments Table

Assessments

Assessment activities will measure the effectiveness of the project implementation and associated QA/QC activities. Audits are used as a means of monitoring the performance of field and laboratory activities and are conducted by the Regional EHS Manager (safety audits), Project QA Manager (TSAs), or a qualified alternate. Audits will include systems audits that are more qualitative in nature and will be made at appropriate intervals to ensure that all aspects of the QA program are operative. Performance audits are quantitative audits that are conducted to assess the accuracy of measurement systems; this would include the use of PE samples.

Safety audits and TSAs will be conducted for field operations to assess implementation of project requirements and determine if the systems under review are capable of meeting project PQOs. These audits will include observations of procedures, discussions with project personnel, and review of records. Any minor deficiencies noted during an audit will be corrected immediately. If a major deficiency is noted during an audit, a stop work order will be issued until the deficiency can be corrected and the effectiveness of the CA measured and documented. A stop work order may be issued by the Regional EHS Manager or Project QA Manager, as appropriate, who will notify the CWCM Task Manager and the AECOM PM. The conditions that lead to a stop work order must be documented in sufficient detail to clearly define the problem and identify possible corrective measures. All communications among project staff that address evaluation of the problem and appropriate solutions must be attached to the stop work order. The Project QA Manager or Regional EHS Manager, the CWCM Task Manager, and AECOM PM must agree in writing to resume work after review of the data supporting correction of the deficiency. The Project QA Manager and Regional EHS Manager will maintain documentation of the deficiencies that were noted, the individual(s) responsible for follow-up, documentation of the effectiveness of the CAs taken, and implementation of procedures to prevent recurrence of the problem.

No project-specific on-site system audits of laboratories are planned for the CWCM. However, participating laboratories are required to take part in regularly scheduled audits required by state and federal agencies as part of ongoing certification or participation in specific contracts. For those audits conducted within 6 months of the start of, or during the course of, the CWCM program, the laboratories must provide copies of the results of these third-party audits to the Project Chemist. Any change in laboratory ownership, management, or certification status must also be immediately reported to the Project Chemist. The Project Chemist, under the direction of the Project QA Manager, will review the third-party audit reports. Any significant deficiencies will require follow up and resolution with the laboratory. The Project Chemist will prepare a written summary of findings and CAs.

The PE program for the CWCM will involve two parts: (1) an evaluation of recent PE data provided by the laboratories and performed as part of their routine participation in USEPA Water Supply (WS) and Water Pollution (WP) certification programs, and (2) analysis of new PE samples purchased by AECOM from a commercial vendor (for example, Resource Technology Corporation). A complete set of blind PE samples for all analyte groups (except for General Chemistry) will be analyzed by both the primary and back-up laboratories before the field sampling begins. An evaluation will be performed by the Project Chemist, who will prepare a written report summarizing the results, actions taken, and resolution of any issues based on the pre-program PE result datasets. In addition to the pre-program PEs, the participating laboratories will analyze known PE samples or certified reference materials (CRMs), which are not blind, at the start of each field sampling event, not to exceed once per calendar quarter. Given the

QAPP Worksheet #31 (UFP-QAPP Manual Section 4.1.1) Planned Project Assessments Table

frequency of the events (8 per year) and that some may occur within a few weeks of each other, PE/CRM samples prior to every sampling event is not warranted. To meet the Quality Control Check Sample (QCCS) analysis requirement for PCDD/Fs, PCBs, and OCPs per Methods 1613B, 1668A, and 1699, a minimum of one PE or CRM sample will be analyzed with field samples per sampling event. If possible, the same QC sample lot used as a blind PE in the pre-program analyses will also be used as the known PE/CRM/QCCS material for the PE samples analyzed during the field program to provide a consistent baseline monitoring of laboratory performance over time. Results for all PE, CRM, and QCCS samples will be reviewed by the Project Chemist. The Project Chemist or data validators will prepare a written summary of findings and CAs.

QAPP Worksheet #32 (UFP-QAPP Manual Section 4.1.2) Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Safety Audit	Written audit report	AECOM PM, CWCM Task Manager, AECOM FTM/SSO	Verbal summary of major findings within 24 hours; written report within one week.	Memo with possible reaudit	AECOM Regional EHS Manager, AECOM PM, CWCM Task Manager	One week
Field TSA	Written audit report	AECOM PM, CWCM Task Manager, AECOM FTM, CPG QA Coordinator, USEPA RPM	Verbal summary of major findings within 24 hours; written report within one week.	Memo with possible reaudit	Project QA Manager, AECOM PM, CWCM Task Manager, CPG QA Coordinator, USEPA RPM	One week
Internal Laboratory Audits	Written audit report	Laboratory Manager	As required by laboratory QMP	Memo or as required by laboratory QMP	Laboratory Manager, Laboratory PM AECOM Project Chemist and Project QA Manager (if project PQOs are affected)	As required by laboratory QMP
External Laboratory Audits	Written audit report	Laboratory Manager	Major deficiencies communicated orally at exit meeting; written report based on policy of external auditing organization	Letter or as required by external auditing organization with possible reaudit	External auditing organization	As required by external auditing organization.
Review of External Laboratory Audit Findings	Written report	AECOM PM, AECOM CWCM Task Manager, AECOM QA Manager, CPG QA Coordinator, USEPA RPM	30 days from receipt of report	Written response	AECOM Project Chemist and AECOM Project QA Manager, USEPA RPM	30 days

QAPP Worksheet #32 (UFP-QAPP Manual Section 4.1.2) Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Non-conformance Reporting	Written report	AECOM PM, AECOM CWCM Task Manager, AECOM QA Manager, CPG QA Coordinator	Verbal summary of major findings within 24 hours; written report within one week.	Memo with possible corrective action	Project QA Manager, AECOM PM, CWCM Task Manager, CPG QA Coordinator	One week
PE samples	Written PE results evaluation report	Laboratory Manager	Deficiencies (results outside acceptance range) identified within one week of receiving laboratory results	Letter with request for laboratory investigation into deficiencies and CA, if necessary, before project field samples are analyzed. CA may include investigation and preparation by the laboratory of a CA report, analysis of a new PE sample, or if AECOM deems appropriate, the analyses may be moved to another lab.	AECOM Project Chemist, Project QA Manager, and CPG QA Coordinator	One week

QAPP Worksheet #32 (UFP-QAPP Manual Section 4.1.2) Assessment Findings and Corrective Action Responses

Non-Conformance/QC Reporting

A non-conformance is defined as an identified or suspected deficiency in, or deviation from, procedures described in an approved document (e.g., improper sampling procedures, improper instrument calibration, errors in calculations or errors in computer algorithms); an item where the quality of the end product itself or subsequent activities conducted using the document or item would be affected by the deficiency; or an activity that is not conducted in accordance with established plans or procedures. Any project staff member that discovers or suspects a non-conformance is responsible for initiating a non-conformance report to the Project QA Manager. The Project QA Manager will evaluate each non-conformance report and provide a response describing the actions to be taken and assigning responsibility for the CA. The appropriate Task Manager will verify that the nonconforming item or procedure is not used until the CA has been performed and found to produce acceptable results. If the non-conformance involves instrumentation or equipment, the device must be tagged to indicate it is defective and not to be used.

A copy of each non-conformance report will be added to the project file. Original non-conformance reports will be maintained by the Project QA Manager or designate.

QAPP Worksheet #33 (UFP-QAPP Manual Section 4.2) QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Progress Reports	Monthly	Due the 15th of each month	AECOM PM/ CPG Project Coordinator	USEPA RPM
Field TSA Reports	Per Worksheet #31	Within one month after field work begins and at least annually or as required during program	AECOM Project QA Manager/auditor	CWCM Task Manager, AECOM PM, CPG QA Coordinator, USEPA RPM
Review of External Laboratory Audit Reports	As required	Within 30 days of submittal by laboratory	AECOM Project QA Manager/Project Chemist	CWCM Task Manager, AECOM PM, CPG QA Coordinator
DVRs	After laboratory data are received and validated	See Worksheet #16	AECOM Validation Coordinator	AECOM Project QA Manager, CWCM Task Manager, and AECOM PM, USEPA RPM
Nonconformance report	As needed	When a nonconformance is identified; submitted as part of monthly progress report	AECOM staff	AECOM Project QA Manager, CWCM Task Manager, AECOM PM, CPG QA Coordinator, USEPA RPM
CA Reports	When CA is required	Within 30 days of resolution of CA	AECOM Project QA Manager or designated Task Manager	AECOM PM, CWCM Task Manager, Project Team Members, CPG QA Coordinator, CPG Project Coordinator, USEPA RPM

The monthly progress report will address the results of any CAs or audits that took place during the reporting period as well as any trends noted during the data validation process. Problems or issues that arise between regular reporting periods may be identified to management at any time. Information included in the monthly progress report will include:

- Results of audits conducted during the reporting period;
- Discussion of problems with measurement data including issues related to precision, accuracy, completeness, representativeness, and comparability that could affect achievement of the PQOs; and
- A listing of any nonconformance reports or stop-work orders, the associated CAs taken, and the outcome of these CAs.

QAPP Worksheet #34 (UFP-QAPP Manual Section 5.2.1) Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification
Field data	Field data, including equipment decontamination records, sample equipment calibration logs, and field measurements, will be reviewed for completeness, accuracy and agreement with SOP LPR-G-01 (Field Records).	Internal	CWCM Task Manager or designee
Chain-of-Custody	The COC will be reviewed initially in the field for complete and correct information.	Internal	AECOM FTM, CWCM Task Manager, or designee
	Upon receipt at the lab, the COC will be compared to sample containers and any discrepancies will be resolved.	External	Laboratory Sample Custodian
	During validation the COC will be verified against laboratory receipt and reporting information.	External	Data Validator
Sample Condition	Holding temperature, holding time and preservation will be reviewed when accepting custody of samples and coolers.	External	Laboratory Sample Custodian
Laboratory Data Packages and EDDs	Laboratory data (hard copy and EDDs) will be verified by the laboratory performing the work for completeness and technical accuracy prior to release.	External	Laboratory
	Laboratory data will be assessed using the validation procedures described in Worksheets #35 and #36.	Internal	Data Validator
Audit Reports	Field system audit reports will be reviewed to confirm that specified CAs have been taken, the CA has been effective and all documentation of CA is attached to the audit report.	Internal	AECOM Project QA Manager or designee
	Internal laboratory audits will be reviewed to confirm that specified CAs have been taken, the CA has been effective and all documentation of CA is complete.	External	Laboratory QA Manager
Assessment actions and reports	QA/QC process will be reviewed for agreement with QAPP/FSP Addendum.	External	ddms, inc., CPG Project QA Coordinator, or designee

QAPP Worksheet #35 (UFP-QAPP Manual Section 5.2.2) Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description	Responsible for Validation
IIa	Field SOPs, field records	Verify conformance to approved sampling and field measurement procedures; ensure that activities met performance criteria; and verify that deviations from procedures or criteria were documented.	Debra Simmons, Project QA Manager/AECOM
IIa	Analytical data deliverables, contractual documents	Verify the required deliverables, analyte lists, method holding times, analytical procedures, laboratory qualifiers, measurement criteria, project quantitation limits, and analyses of PE samples conform to specifications. Verify that deviations from procedures or criteria were documented.	Lisa Krowitz, Validation Coordinator/AECOM
IIa	Field records, database output	Verify transcription of field data from field forms to database.	Jim Herberich, Data Management Task Manager/AECOM
IIa	Custody records, analytical data reports	Review traceability from sample collection through reporting.	Lisa Krowitz, Validation Coordinator/AECOM
IIa	Laboratory EDDs, analytical data reports, database output	Verify EDDs against hard-copy analytical reports.	Jim Herberich, Data Management Task Manager/AECOM
IIa	Data validation reports, database output	Verify that entry of qualifiers was correct and complete.	Lisa Krowitz, Validation Coordinator/AECOM
IIb	Analytical data reports	Verify that reported analytes, holding times, analytical procedures, measurement criteria, and project quantitation limits conform to the QAPP. Verify that deviations from procedures or criteria were documented.	Lisa Krowitz, Validation Coordinator/AECOM
IIb	Analytical data reports, validation guidance	Combination full/limited data validation (see details below)	Lisa Krowitz, Validation Coordinator/AECOM
IIb	QAPP, analytical data reports, validation guidance	Verify that the qualifiers applied during validation were in conformance with the QAPP and specified validation guidance.	Lisa Krowitz, Validation Coordinator/AECOM

QAPP Worksheet #35 (UFP-QAPP Manual Section 5.2.2) Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description	Responsible for Validation
IIb	Analytical data reports	Verify that all project required PE samples were analyzed and that results met the acceptance criteria.	Lisa Krowitz, Validation Coordinator/AECOM
IIb	QAPP, data validation reports	Verify that data validation was performed in accordance with the QAPP specifications and that all required peer reviews were conducted. If validation actions deviated from the QAPP specifications and/or regional validation guidance based on professional judgment, verify that rationale was documented.	Debra Simmons, Project QA Manager/AECOM

Data Validation

Validation of each analytical group will be limited to the target analytes listed in Worksheet #15 for that group. At a minimum, 100% full validation (includes review of raw data and spot check for verification of calculations) will be conducted for PCDD/PCDFs (the 2,3,7,8-substituted Congeners and Homologs listed in Worksheet #15), and all 209 PCB Congeners and Homologs, OC Pesticides, PAHs and AlkylPAHs, mercury and methyl mercury for each sample delivery group (SDG). For all other parameters, 100% full validation (as appropriate to the analyses) will be performed on the first SDG. The remaining SDGs will be subject to full validation for every fifth SDG, and limited validation for the remaining SDGs.

Limited validation will be based on information provided by the laboratory on their QC forms, and will include no or minimal raw data review. At a minimum, limited validation will include the following data elements:

- Agreement of analyses conducted with COC requests
- Holding times and sample preservation
- Initial and continuing calibrations and analytical sequence
- Mass spectrometer tuning (GC/MS only)
- Internal standard performance (GC/MS only)
- Laboratory blanks/equipment rinsate blanks/ trip blanks
- Surrogate recoveries
- LCS (or equivalent) results
- MS/MSD results

QAPP Worksheet #35 (UFP-QAPP Manual Section 5.2.2) Validation (Steps IIa and IIb) Process Table

- Field duplicate results
- ICS results (AB solution only)
- ICP serial dilution results
- Quantitation limits and sample results (limited to evaluating dilutions and reanalyses)

If significant issues (e.g., those affecting achievement of the PQOs) are noted during full validation, the limited validation may be expanded to include this issue. Systematic or random errors that would not be detected during a review of the summary forms might include, for example, misidentification or quantitation of compounds, transcription errors, or calculation errors. In addition, limited validation will provide review of key laboratory QC elements, which would highlight potential underlying lab issues that may require further investigation (i.e., full validation effort). If a high frequency of measurement performance issues is found, the issue will be investigated and an additional validation effort may be implemented. AECOM plans to maintain communication/notification systems with the laboratory during the analytical process to circumvent significant QC issues. If QC issues do arise, investigations and CAs will be documented and implemented in a timely fashion to optimize the amount of un-qualified data.

In addition, data packages receiving limited validation will receive a completeness check so that full validation could be performed at a later date, if necessary. The check will verify that the raw data for each sample (including all reanalyses and dilutions) are present and complete. The data supporting the sample results, such as QC samples (method blanks, LCS, MS/MSD), calibrations, tunes, and preparation logs, will also be reviewed for overall completeness, however, an in-depth inventory to ensure specific association with all sample data will not be performed.

No additional completeness check will be performed for the bacterial or protozoan tests due to limited back-up information provided and the nature of the tests.

The qualifiers applied during validation will be consistent with those in the validation guidance and are summarized in the table below. Qualifiers will be applied based on the criteria in the QAPP, method-specific Region 2 validation guidance, or professional judgment. Method-specific validation SOPs will be prepared to explain the rules for qualifier application and to minimize differences due to professional judgment. DVRs summarizing data qualification as a result of the validation effort will be prepared and submitted as described in Worksheet #16.

QAPP Worksheet #35 (UFP-QAPP Manual Section 5.2.2) Validation (Steps IIa and IIb) Process Table

Validation Qualifier	Explanation
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample. "J" flags will be assigned by the validator based on nonconformance with the validation criteria (for example, holding times, surrogate recoveries) noted in Worksheet #36. In addition, "J" flags applied by the laboratory due to results being between the QL and MDL or EDL will be retained during validation.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".
JN	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
UJ	The analyte was not detected above the reported sample QL. However, the reported QL is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
U	The analyte was analyzed for, but was not detected above, the reported sample QL.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified.

QAPP Worksheet #36 (UFP-QAPP Manual Section 5.2.2) Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria*	Data Validator (title and organizational affiliation)
IIa	Water	Metals (total and dissolved)	Low	Region 2 validation SOP HW-2, modified for method	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIa	Water	Butyltins	Low	Region 2 validation SOP HW-44, modified for method	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIa	Water	PCDD/PCDFs	Low	Region 2 validation SOP HW-25	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIa	Water	Low Level Mercury (total and dissolved)	Low	Region 2 validation SOP HW-2, modified for method	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIa	Water	Methyl Mercury (total and dissolved)	Low	Region 2 validation SOP HW-2, modified for method	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIa	Water	Hexavalent Chromium	Low	NJDEP SOP 5.A.10, rev. no. 2, modified	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIa	Water	OC Pesticides	Low	Region 2 validation SOP HW-25, modified for method	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIa	Water	PCBs – Homologs and Congeners	Low	Region 2 validation SOP HW-46	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIa	Water	SVOCs	Low	Region 2 validation SOP HW-22	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIa	Water	PAHs and Alkyl PAHs – LRMS-SIM	Low	Region 2 validation SOP HW-22, modified for method	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIa	Water	VOCs	Low	Region 2 validation SOP HW-24	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIa	Water	General chemistry	Low	QAPP Worksheets 12, 15, 19, and 24	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIa	Water	Bacterial	Low	QAPP Worksheets 12, 15, and19	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIb	Water	Metals	Low	Region 2 validation SOP HW-2, modified, and/or QAPP Worksheets 12, 15, 19, and 24	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIb	Water	Butyltins	Low	QAPP Worksheets 12, 15, 19, and 24	Lisa Krowitz, Validation Coordinator/AECOM (or designate)

QAPP Worksheet #36 (UFP-QAPP Manual Section 5.2.2) Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria*	Data Validator (title and organizational affiliation)
IIb	Water	PCDD/PCDFs	Low	Region 2 validation SOP HW-25 and/or QAPP Worksheets 12, 15, 19, and 24, whichever is more stringent	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIb	Water	Low Level Mercury	Low	QAPP Worksheets 12, 15, 19, and 24	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIb	Water	Methyl Mercury	Low	QAPP Worksheets 12, 15, 19, and 24	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIb	Water	Hexavalent Chromium	Low	NJDEP SOP 5.A.10, rev. no. 2, modified, and/or QAPP Worksheets 12, 15, 19, and 24	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIb	Water	OC Pesticides	Low	QAPP Worksheets 12, 15, 19, and 24	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIb	Water	PCBs – Homologs and Congeners	Low	Region 2 validation SOP HW-46 and/or QAPP Worksheets 12, 15, 19, and 24	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIb	Water	SVOCs	Low	Region 2 validation SOP HW-22 and/or QAPP Worksheets 12, 15, 19, and 24, whichever is more stringent	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIb	Water	PAHs and Alkyl PAHs – LRMS-SIM	Low	QAPP Worksheets 12, 15, 19, and 24	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIb	Water	VOCs	Low	Region 2 validation SOP HW-24 and/or QAPP Worksheets 12, 15, 19, and 24, whichever is more stringent	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIb	Water	General chemistry	Low	QAPP Worksheets 12, 15, 19, and 24	Lisa Krowitz, Validation Coordinator/AECOM (or designate)

QAPP Worksheet #36 (UFP-QAPP Manual Section 5.2.2) Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria*	Data Validator (title and organizational affiliation)
IIb	Water	Bacterial	Low	QAPP Worksheets 12, 15, 19, and 24	Lisa Krowitz, Validation Coordinator/AECOM (or designate)
IIb	Water	Protozoans	Low	QAPP Worksheets 12, 15, 19, and 24	Lisa Krowitz, Validation Coordinator/AECOM (or designate)

*Validation criteria include professional judgment where appropriate and necessary. The most current versions of the Region 2 data validation SOPs will be used. Note that modifications to the Region 2 data validation SOPs are performed when there is no SOP for the specified method. In those cases, the most relevant Region 2 data validation SOP is used as a reference, and modified for method- specific criteria, with the validation actions being consistent with Region 2 guidance where possible. Modifications to the Region 2 SOPs may also be made to incorporate the performance measurement criteria for this project. Modifications will be discussed in the DVRs.

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:
AECOM's data validation staff will validate all laboratory data in accordance with the protocols described in Worksheet #36. The Project QA Manager, in conjunction with the project team, will determine whether the analytical data meet the requirements for use in making decisions related to further actions at the site. The results of laboratory measurements will be compared to the PQOs described in Worksheet #11 of this document.

Describe the evaluative procedures used to assess overall measurement error associated with the project:
During the data validation process the validator will use information confirming sample identification; sample preparation; analysis within holding time; instrument calibration data; and results of QC samples designed to assess blank contamination, analytical precision, and accuracy to identify any limitations in data use and, if known, data bias. The validator will apply qualifiers as needed to reflect any limitations on the use of specific data points and prepare a report detailing the information reviewed, data limitations, and overall usability. Patterns of data use limitations or anomalies that become apparent during the validation process or as the users evaluate the data will be reviewed with the Project QA Manager and the appropriate laboratory. Data that do not meet the quality acceptance limits of Worksheet #28, or quality levels of Worksheet #15, or analytical performance criteria specified in Worksheet #12 will be clearly identified in the database so data users are aware of any limitations associated with data usability. Data that were flagged with an "R" (rejected) during data validation are not considered usable and will not be used to make decisions related to further actions at the site. Details of the problems identified during data validation and the bias in the data will be provided in the associated DVR.

Identify the personnel responsible for performing the usability assessment:
Data validation will be performed by data validation staff under the supervision of the Project QA Manager. The usability assessment will be performed jointly by the AECOM and CPG project teams and will include input by field personnel, QA staff, project chemists, and project management. The CWCM Task Manager will be responsible for the data usability assessment.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:
The documentation generated during data validation will include a DVR that describes the information reviewed, the results of this review and provides a recommendation on overall data usability and limitations on specific data points. The DVR and associated validation documentation will provide information on the samples included in the review and the date they were collected; the condition of samples when received at the laboratory and any discrepancies noted during the receiving process; verification of sample preparation and analysis within the method specified holding time; instrument calibration information; review of associated QC analyses including blanks, LCSs, matrix spikes, and field and/or laboratory duplicates; and verification of selected reported values from raw data. As a result of this review, standard qualifiers will be entered into the database so that data users can readily identify any limitations associated with a specific data point.

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) Usability Assessment

Assessment of data usability will be performed by data validation staff using current USEPA Region 2 data validation guidance. The results of the Data Usability Assessment will be summarized in the final Technical Memorandum. The following items will be assessed and conclusions drawn based on their results:

Holding Time: All sample data will be checked to verify that both sample preparation and analysis were performed within the method required holding time.

Calibration: Data associated with instrument calibration and verification of calibration will be reviewed to confirm that all data were generated using properly calibrated instrumentation.

Accuracy/Bias Contamination: Results for all equipment rinsate blanks, trip blanks, laboratory method blanks, and instrument calibration blanks will be checked against performance criteria specified in Worksheet #28; results for analytes that exceed criteria will be identified and the impact on field sample data will be assessed. Data will be summarized by type of blank.

Accuracy/Bias Overall: Reported values of LCSs and matrix spikes will be evaluated against the spiked or certified concentration and the percent recovery will be calculated and compared to the criteria specified in Worksheet #28. The percent recovery information will be used to assess the bias associated with the analysis. Recovery for matrix spikes in conjunction with the recovery reported for LCSs will provide information on the impact of the sample matrix on specific analyses. Accuracy will be calculated as follows: where X = the observed value of measurement and T = 'true' value

$$Accuracy = \frac{X}{T} \times 100$$

Precision: Results of the RPD will be calculated for each analyte in laboratory and field duplicates. These RPDs will be checked against measurement performance criteria presented on Worksheet #28; RPDs exceeding the stated criteria will be identified. Any limitations on the use of the data based on precision problems will be reported. The RPD is calculated as follows:

where: RPD = relative percent difference; D_1 = first sample value; and D_2 = second sample value (duplicate)

$$RPD = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \times 100$$

Sensitivity: Reporting limits will be checked against the Project Action Levels presented on Worksheet #15 and QLs presented on Worksheet #15. Limitations on the use of the data and conclusions about the sensitivity of the analysis will be reported.

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) Usability Assessment

Representativeness: A review of field records will be used to confirm that sample collection and handling was performed in a manner that conformed to the designated SOP. Similarly, laboratory preparation procedures will be reviewed during validation to ensure that a representative sample was selected for analysis. Any deviations or modifications to field or laboratory procedures that might impact the representativeness of the sample will be discussed in the Technical Memorandum.

Comparability: The sampling and analytical procedures that will be used in this program have been selected to ensure that the resulting data will be comparable to data from similar programs conducted previously or which will be conducted in the future. Any modifications or deviations from stated procedures that might impact data comparability will be addressed in the Technical Memorandum.

Completeness: Completeness for the analytical program will be calculated as the number of data points that are accepted as usable based on the validation process divided by the total number of data points for each analysis. Completeness will be reported for each analytical category and an overall value will be reported. As shown in Worksheet #12, the analytical completeness goal is ≥90%. Completeness for the field program will be calculated as the number of samples successfully collected compared to the total number proposed in this QAPP/FSP Addendum. The completeness goal for the field sampling program is ≥95%. Percent completeness will be calculated as follows: where X = the number of usable data points and T = total data points

$$Completene\ ss = \frac{X}{T}\ x\ 100$$

The Project QLs presented on Worksheet #15 will be reviewed to determine if the stated objective was met. The major impacts observed from data validation, DQI and measurement performance criteria assessments will be used to assess the overall data quality and whether Project QLs were achieved. The final Technical Memorandum will summarize the information used to reconcile each objective and overall conclusions regarding data quality.

Attachment 1

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Appendix A

WCM/Chemical Data Collection
Field Sampling Plan Addendum
Lower Passaic River Restoration Project

1.0 Introduction

This Field Sampling Plan (FSP) has been prepared by the Cooperating Parties Group (CPG) as an addendum to the Lower Passaic River Restoration Project (LPRRP) FSP, Volume 1 (MPI 2006). The survey and sampling activities described in this FSP Addendum were designed as part of a Water Column Monitoring (WCM) Program in support of the Remedial Investigation and Feasibility Study (RI/FS) that the CPG is required to carry out under the Settlement Agreement (USEPA 2007). The WCM Program has been divided into two subtasks. The first subtask (addressed in the FSP 2009-01 Addendum and termed the WCM/Physical Data Collection or Physical WCM (PWCM)) (AECOM 2010a) includes collection of physical measurements in the water column (currents, temperature, conductivity, turbidity and solids). The second subtask (addressed in this FSP Addendum and termed the WCM/Chemical Data Collection or Chemical WCM (CWCM) Program) includes sampling and analysis of chemicals in the water column as well as certain physical measurements (such as additional solids and particle size distributions). The design and plan for this second subtask was developed following initiation of the physical data collection, building on the data initially collected.

The proposed investigation described in this FSP Addendum for the CWCM Program includes the collection of small volume surface water samples from multiple stations on the Lower Passaic River (LPR), Newark Bay and its associated waterways. The sampling will be conducted throughout a one year period at up to 17 stations including the lower 17.4 miles of the LPR, the LPR's major tributaries (Second River, Third River and Saddle River), the LPR above Dundee Dam, five locations in Newark Bay, and Newark Bay's major tributaries (Hackensack River, Arthur Kill and Kill van Kull). The program includes different sampling strategies based on the specific flow and/or tidal conditions for each event type. The plan for this investigation includes the following components:

- A Quality Assurance Project Plan (QAPP) has been prepared for this portion of the investigation detailing the proposed monitoring and associated field, laboratory, and data validation and management methodologies. The QAPP has been prepared following the "Uniform Federal Policy for Implementing Quality Systems" (USEPA 2005) and includes the following documents as appendices:
  - This FSP Addendum is provided as an overview of the proposed field investigation and is included as Appendix A to the QAPP.
  - Standard operating procedures (SOPs) covering the field elements of the proposed investigation are included as Appendix B to the QAPP.
  - Related laboratory SOPs are included as Appendix C to the QAPP.
- A Health and Safety Plan (HASP) Addendum (based on the overall LPRRP HASP [MPI 2005a]) addressing the work elements specific to this investigation will be submitted under a separate cover.

1.1 Site background

The Lower Passaic River Study Area (LPRSA) encompasses the 17.4-mile tidal reach of the Passaic River below the Dundee Dam, its major tributaries, and the surrounding watershed that hydrologically drain below the Dundee Dam. Overall goals of the RI/FS and a description of the associated investigations have been presented in the Work Plan (MPI 2005b), three FSPs (FSP1 [MPI 2006], FSP2 [MPI et al. 2006], and FSP3 [MPI 2005c]), and a QAPP (MPI 2005d). The CWCM program includes sampling in the Newark Bay Study Area (NBSA), which includes Newark Bay, and the confluences of the Hackensack River, Arthur Kill and Kill

van Kull to Newark Bay. Sampling in the NBSA will support the chemical fate and transport (CFT) model and may be used to support the NBSA risk assessment.

1.2 Conceptual site model

A conceptual site model (CSM) and methods to update the CSM were developed to examine the assumed sources of contaminants, routes of environmental transport, contaminated media, routes of exposure, and receptors (MPI 2007). The data generated by the investigation described in this FSP Addendum will be used to update the CSM, support numerical modeling of the LPRSA and the NBSA, support the risk assessments (RAs) and guide potential future data collection efforts.

1.3 Sampling objectives

While the detailed design of the CWCM program was not fully developed in FSP1, the program outline suggested a complex and multiple-phase sampling program. AECOM has worked with the end users of the data (i.e., human health risk assessment (HHRA) and ecological risk assessment (ERA) teams, the food web model (FWM) team and CFT model team) to develop data use objectives (DUOs) and data quality objectives (DQOs) for the CWCM program. Using the DQO/DUOs, a strategy for the CWCM program has been developed. This FSP Addendum presents the CWCM strategy, with justification for the sampling design and confirmation of the ability to achieve the DQO/DUOs developed by the end users (QAPP Worksheet #11).

A critical issue in the development of a CWCM program is the need to measure the concentrations of constituents present in the water column at low levels, particularly hydrophobic organic constituents (HOCs) such as polychlorinated dibenzo-*p*-dioxins/polychlorinated dibenzofurans (PCDD/PCDFs), some polychlorinated biphenyl (PCB) congeners, and some semi-volatile organic compounds (SVOCs). For this reason, FSP1 incorporated high volume sample collection methods. These methods have practical implementation constraints. For instance, the time required to collect a single sample limits the ability to capture representative point and quasi-synoptic data (e.g., slack tide). These constraints also make the methods costly to implement. The proposed CWCM program, therefore, relies primarily on small volume water sampling detailed in the QAPP and FSP, supplemented by a subset of high volume sampling (approximately 10% of small volume samples). This phase of the CWCM program includes only small volume water sampling. A program for high volume sampling is being developed as an addendum to the CWCM QAPP.

Broadly defined, the goals of the CWCM Data Collection Program are to:

1. Collect data to support the calibration, validation, and sensitivity analysis of the CFT model. The data will provide information to develop the inflows to the model and to characterize the transport of contaminants in the LPRSA, above Dundee Dam, and the NBSA, including the flux of contaminants from the sediments to the water column through routine monitoring events. Water column contaminant concentration data collected in the LPRSA, above Dundee Dam and the NBSA with sufficient spatial coverage and frequency and over a range of flow conditions will be used to characterize potential gradients, mixing and general inputs to the system.
2. Collect data to characterize the impacts of storm-induced high flow (i.e., not sustained high flow) conditions on contaminant sources and transport in which resuspension of contaminants from the sediment bed and subsequent deposition from the water column are expected to dominate other transport processes. Water column contaminant concentration data collected during high flow

conditions will be used to assess the potential for increased contaminant loading to the water column from upstream sources and/or through resuspension of existing sediments.

3. Collect data to characterize the transport of contaminants under conditions of high upstream tidal flow, which occurs during low flow conditions at spring tides. Water column contaminant concentration data collected during a combination of low flow and spring tide conditions will be used to better assess the up-river transport potential and support the understanding of the fate and transport for the LPRSA CSM and LPR/Newark Bay Model.
4. Estimate average water column concentrations of contaminants in the LPRSA for use in exposure point concentration estimation for the HHRA, ERA and FWM.

These monitoring goals have been designed to support the ongoing RI site characterization and modeling efforts. The high volume sampling program will be used to address RI site characterization efforts for the HOCs that may not be detected at levels that meet the project action levels (PALs) of the small volume program. Further details of the high volume sampling program will be provided in the high volume QAPP and FSP Addendum.

2.0 Field activities

2.1 Overview

The flow thresholds for the low flow and high flow events were selected from an analysis of the discharge record at Dundee Dam (April 2007 to August 2010). The low flow event threshold was identified by conducting an analysis of the number of events satisfying both the discharge criterion and the spring-tide criterion. The analysis showed that a discharge criterion of <400 cfs was satisfied multiple times (i.e., 8-12 times per calendar years 2007-2009) in each of the years over the period of record at Dundee Dam.

The high flow threshold was identified by conducting a return frequency analysis using the available discharge data at Dundee Dam. A flow event with a return period of 3 months (or 4 occurrences per year) was chosen as the flow threshold that can reasonably be expected to be exceeded during the CWCM period. Accordingly, the discharge associated with the 1 in 3 months event at Dundee Dam was calculated to be 3,000 cfs and is proposed as the minimum flow for a high flow event. High flow sampling will be triggered following seven days of normal (i.e., < 3,000 cfs) flows.

In summary, the proposed CWCM small volume program includes the following three elements:

- **Routine Events** - Water samples will be collected at 17 locations in the LPRSA (including the LPRSA tributaries), above Dundee Dam, Newark Bay, Hackensack River, Arthur Kill, and Kill van Kull for laboratory analysis. A total of five hundred forty (540) samples will be collected through five Routine Events spread over winter (one event), spring (two events), and summer (two events). At least one Routine Event will occur during a spring tide, and one during a neap tide. The sampling events will be conducted over a variety of flow conditions, from 400 to 3,000 cubic feet per second (cfs) at Dundee Dam. The locations of samples collected during flows of < 1,000 cfs will be determined based on flow and tide stage (see Exhibit 1). Where commercial boat traffic does not prohibit anchoring, samples will be collected from the deepest part of the river (thalweg). The thalweg will be determined in the field by measuring and recording the depths across the river at each location, and identifying the deepest point. Samples will be collected at two depths (3 feet (ft) below surface and 3 ft from the bottom) for the stations in the LPR (River Mile [RM] 0 - 17.4) and the NBSA, and at mid-depth for the LPRSA

tributaries and above Dundee Dam. The samples will be collected during the five Routine Events with most stations sampled four times during the tidal cycle and at the depths indicated above. The station above Dundee Dam and the tributaries will each be sampled one time during each event.

- **Low Flow/Spring Tide Event -** Water samples will be collected during low flow (< 400 cfs at Dundee Dam) and spring tide conditions at eight locations in the LPR and its tributaries for laboratory analysis. The tributary locations, the station above Dundee Dam and RM 1.4 will be the same as those sampled in the Routine Events. The most upstream location will be located at RM 10.2 (flow 250 - 400 cfs) or RM 13.5 (flow < 250 cfs). Other station locations in the LPR will be determined based on the flow and tide stage in the river (see Exhibit 1). Samples will be collected from the thalweg and at two depths (3 ft below surface and 3 ft from the bottom) for the stations in the LPR (RM 0 - 17.4), with each station sampled four times during the tidal cycle and at the depths indicated above. For the tributaries and above Dundee Dam, each station will be sampled once at mid-depth. A total of forty-four (44) samples will be collected during the Low Flow/Spring Tide Event. It is anticipated the Low Flow/Spring Tide Event will occur in the late summer to early autumn.
- **High Flow Events -** Water samples will be collected during storm-induced high flow (i.e., not sustained high flow) conditions (>3,000 cfs at Dundee Dam) at 17 locations in the LPRSA (including the LPRSA tributaries), above Dundee Dam, Newark Bay, Hackensack River, Arthur Kill, and Kill van Kull for laboratory analysis. Stations will be co-located with the fixed (i.e., for flows > 1,000 cfs) Routine Event stations. Fourteen (14) stations will be sampled four times each throughout the predicted storm hydrograph; the station above Dundee Dam will be sampled six times throughout the predicted storm hydrograph. Samples collected from the Arthur Kill and Kill van Kull will be sampled at high and low slack water. Samples will be collected from the thalweg and at two depths (3 ft below surface and 3 ft from the bottom) for the stations in the LPR (RM 0 – 17.4) and the NBSA, and at mid-depth for the tributaries and above Dundee Dam. A total of two hundred twenty-eight (228) samples will be collected during two separate High Flow Events. The High Flow events will be conducted based on the flow conditions, but are likely to occur during the spring and very early summer.

Target sampling coordinates for fixed locations are presented in Table 1 and illustrated for the overall survey area in Figure 1.

Table 1: CWCM Program Sampling Station Target Coordinates

Sampling Location	Station Name	Target Coordinates NAD83 NJ State Plane feet (ft)	
		Easting	Northing
Above Dundee Dam	T175	594536	747557
RM 13.5[a] T135		597204	734288
RM 10.2[b] T102		592153	719744
RM 6.7[c] T067		586132	702831
RM 4.2[c] T042		588234	692388
RM 1.4	T014	597906	691249
RM 0	T000	597437	683215
Tidal 1[d] TBD		TBD	TBD
Tidal 2[d] TBD		TBD	TBD

Sampling Location	Station Name	Target Coordinates NAD83 NJ State Plane feet (ft)	
		Easting	Northing
Third River	T3R1	593685	726123
Saddle River	TSR1	605766	743410
Newark Bay North	TNBN	597246	677109
Newark Bay East	TNBE	595586	670959
Newark Bay Northeast	TNNE	599590	680260
Newark Bay Northwest	TNNW	595916	677291
Newark Bay South	TNBS	590441	663600
Arthur Kill	TARK	579874	660352
Kill Van Kull	TKVK	595168	659376
Hackensack River	THKN	605562	693977

Notes:
[a] Sampled when flow at Dundee Dam < 250 cfs
[b] Sampled when flow at Dundee Dam > 250 cfs
[c] Sampled when flow at Dundee Dam > 1,000 cfs
[d] Sampled when flow at Dundee Dam < 1,000 cfs
TBD = To be determined. See Exhibit 1.

Samples will be collected by peristaltic pump following Standard Operating Procedure (SOP) LPR-FI-04 and SOP LPR-FI-06 (SOPs are included in Appendix B of the QAPP). Samples for metals (SOP LPR-FI-06) will be sampled first at each station. Total recoverable and dissolved metals including methyl mercury will be sampled first using the peristaltic pump. Note that hexavalent chromium will only be collected as a filtered sample per the analytical method. Following the completion of metals sampling using the pump sampler, the remaining analytes will be collected. Bottles for constituents will be filled in decreasing order of constituent volatility. Bottles for Target Compound List (TCL) volatile organic compounds (VOCs) will be filled first, immediately upon retrieval of the sampler, followed by total organic carbon (TOC). The remaining bottles will be filled sequentially, per SOP LPR-FL-04.

River water that is collected during the sampling but is not needed to fill the required sample containers will be temporarily containerized, and will be returned to the river upon completion of sampling at each station, consistent with SOP LPR-G-04. A continuous water column profile of temperature, dissolved oxygen, pH, turbidity, salinity and conductivity will be measured at each station prior to sample collection and immediately following sample collection according to SOP LPR-FI-05. The second profile, collected at the conclusion of sampling at a station in the same manner as the profile collected prior to sampling, will document any changes in the water column. At stations greater than 6 feet deep and those where two depth intervals will be sampled, the data sonde will be lowered to 3 feet above the bottom and allowed to stabilize. The meter will be raised manually at a speed not to exceed 1 foot per second, depending on the manufacturer's specifications for the response time of the sensors, recording continuously. When the data sonde reaches the second sampling depth of 3 feet below surface, a second fixed reading will be taken to indicate the conditions at the sampling interval. At stations where only one depth is to be sampled, the meter will be allowed to stabilize at the sampling depth. As indicated in SOP LPR-FI-05, this profile will be measured prior to, and immediately following sampling in order to document any changes in the water column. These *in-situ* parameters will also be measured continuously during sampling collection at the target depth. The depth will be measured using a graduated line, depth gage and the vessel fathometer.

Samples will be analyzed for a suite of chemicals similar to that analyzed in the fish/decapod tissue collection (Windward 2009a) and benthic sediment sampling programs (Windward 2009b), including PCDD/PCDFs, PCB congeners and homologs, polycyclic aromatic hydrocarbons (PAHs), alkyl PAHs, TCL SVOCs and associated tentatively identified compounds (TICs), TCL VOCs and associated TICs, butyltins, organochlorine (OC) pesticides, mercury (Hg), methyl mercury, Target Analyte List (TAL) metals, titanium (Ti), and cyanide. In addition to these parameters, samples from this program will also be analyzed for selected physical parameters, including suspended solids concentration (SSC), total dissolved solids (TDS), organic carbon fractions (total, dissolved and particulate), chlorophyll a, nutrients and anions (i.e., phosphorous, sulfide, sulfate, chloride, ammonia [NH_3-N], total Kjeldahl nitrogen [TKN]), hardness (calculated), and alkalinity. Approximately 10% of the LPR samples will also be analyzed for pathogens to support the HHRA. The full list of constituents is presented in Worksheet #15 of the QAPP.

Not all analytes will be analyzed during every sampling event. A list of priority analytes (Group A) will be analyzed in samples from every event; the priority analytes and additional analytes (Group B) will be analyzed in samples collected during a subset of events. In addition, pathogens (Groups C and D) will be analyzed in a subset of LPRSA stations. The Group A priority analyte suite was developed based on the Modeling Work Plan (HydroQual, 2006) and in consultation with the CFT modeling team and United States Environmental Protection Agency (USEPA), and will be used to calibrate the CFT model.

Group A (the priority analyte suite) includes PCDD/PCDFs, PCB congeners and homologs, mercury, cadmium, copper, lead, the organic carbon fractions, the solids fractions, chlorophyll a, alkalinity, and the major anions (sulfide, sulfate, and chloride). Group A analytes will be used to calibrate the CFT model, and provide water column data to support the RAs and FWM.

Group B includes methyl mercury (total and dissolved), the remaining TAL metals (total and dissolved, where applicable), dissolved hexavalent chromium, Ti, cyanide, SVOCs, VOCs, butyltins, PAHs, alkyl PAHs, OC pesticides, hardness, and nutrients (i.e., phosphorus, TKN, and NH_3-N). Group B analytes will be measured in all samples collected during the Low Flow/Spring Tide Event, one spring and two summer Routine Events, and one High Flow Event. Group B analytes will be used to support the RAs and FWM, and validate the CFT model.

Group C includes coliform bacteria: total coliform, *Escherichia coli* (*E. coli*), fecal coliform, fecal *Streptococci* and fecal *Enterococci.* Group C analytes will be measured in the samples collected 3 ft below the surface, once during both spring Routine Events, both summer Routine Events, both High Flow Events, and the fall Low Flow/Spring Tide Event, at the five stations located in RM 0 – 17.4 of the LPRSA only (the NBSA, above Dundee Dam, and the LPRSA tributaries will not be sampled for Group C analytes). Group C analytes will be used in the HHRA.

Group D analytes include the protozoan pathogens *Giardia* and cryptosporidium. Group D analytes will be measured in the samples collected 3 ft below surface, once during each summer Routine Event and during both High Flow Events at the five stations located in RM 0 – 17.4 of the LPRSA only (the NBSA, above Dundee Dam and LPRSA tributaries will not be sampled for Group D analytes). Group D analytes will be used in the HHRA.

2.2 Details of field activities

Routine Events. The objectives of the Routine Event program are to capture data representative of the influxes and mixing processes in the river and Newark Bay, the deposition of particulates from the water column to the sediment, and of the preliminary flux of contaminants from the sediment to the water column. The conditions under which such processes would be apparent are likely to be low to medium flows at the Dundee Dam boundary. These data will be used to calibrate the CFT model to these conditions, and to provide exposure concentration data for the RAs and FWM.

Five Routine Events will be conducted over the course of one year under normal flow conditions (400 - 3,000 cfs at the gage at Dundee Dam). The five events are planned to occur in winter (one event), spring (two events) and summer (two events). This provides data throughout most of the year (sampling in the fall will be conducted under Low Flow/Spring Tide conditions, see below) while focusing the sampling during the seasons of highest human use and biological activity. At least one Routine Event will be sampled during a spring tide, and one Routine Event will be sampled during a neap tide. The sample locations will include the LPRSA, above Dundee Dam, and the NBSA (QAPP Worksheet #18). The data collected during the Routine Events will provide data to support the exposure point calculations for the RAs and FWM. A variety of flows ranging from 400 - 3,000 cfs at Dundee Dam are planned for the Routine Events, designed to provide information regarding the variability of chemical concentrations in the study area to support the calibration of the CFT model. Up to one hundred eight (108) samples will be collected during each of the Routine Events to be analyzed for target analytes as defined in QAPP Worksheet #15. Group A analytes will be sampled in each event. Group B analytes will be measured in one spring and two summer events. Shallow (3 ft below surface) water stations in the five locations in the lower 17.4 miles of the LPR will be analyzed for pathogens (QAPP Worksheets #15 and #18). Group C analytes (coliform bacteria) will be analyzed in the two spring and two summer events; and Group D analytes (*Giardia* and cryptosporidium) will be sampled during the summer events. Frequency and type of quality control (QC) samples are provided in QAPP Worksheet #20.

It is anticipated that the events will bracket “normal” flow conditions and ideally occur during two different flow regimes measured at the Dundee Dam United States Geologic Survey (USGS) gage (low to medium flow: 400 - 1,000 cfs and medium to high flow 1,000 – 3,000 cfs). Seventeen stations, generally located at the same stations as those sampled in the PWCM program, will be sampled at the thalweg, when feasible, during the Routine Events (Table 2 and Figure 1). The locations for flows > 1,000 cfs are fixed locations. When flows are 400 - 1,000 cfs, the location of two of the river stations (Tidal 1 and Tidal 2) will be determined within 48 hours of the time of the survey based on the extent of the salt wedge (Exhibit 1). One of these stations, Tidal 1, will be located approximately one mile downstream of the toe of the salt wedge. Tidal 2 will be located halfway between Tidal 1 and the station at RM 1.4 (but not upstream of RM 4.2). The discharge used to determine Tidal 1 will be based on an average of the prior 7 days discharge at the USGS gage at Dundee Dam and using National Oceanic and Atmospheric Administration (NOAA) predictions from the gage at Dundee Dam on the Passaic River. A total of up to five hundred forty (540) samples will be collected over five surveys in the Routine Events (Table 3). Each Routine Event will be conducted within approximately a four-day period. General weather conditions, such as precipitation and wind speed and direction will be recorded during the sampling period.

The Routine Event sampled in winter will consist of Group A analytes only. One spring event will consist of Group A and Group C analytes. The remaining spring Routine Event will include Group A, Group B and Group C analytes. The two summer Routine Events will include Group A, Group B, Group C and Group D analytes. Groups C and D analytes will be collected only at the five locations in lower 17.4 RM of the LPR.

Table 2: Chemical Data Collection Program Sampling Stations for Routine Events

Location	Event Sampling Strategy
Upper River: RM 10.2 for flows > 250 cfs RM 13.5 for flows < 250 cfs	Four times (just before low slack tide, maximum flood tide, just before high slack tide and maximum ebb tide)[1] at two depths (3 ft below surface and 3 ft above bottom)
Lower River: RM 0 RM 1.4 RM 4.2 for flows > 1,000 cfs [Tidal 1 for flows < 1,000 cfs (see Exhibit 1)] RM 6.7 for flows > 1,000 cfs [Tidal 2 for flows < 1,000 cfs (see Exhibit 1)]	Four times (just before low slack tide, maximum flood tide, just before high slack tide and maximum ebb tide)[1] at two depths (3 ft below surface and 3 ft above bottom)
Newark Bay North[2]	Four times (just before low slack tide, maximum flood tide, just before high slack tide and maximum ebb tide)[1] at two depths (3 ft below surface and 3 ft above bottom)
Newark Bay East[2]	Four times (just before low slack tide, maximum flood tide, just before high slack tide and maximum ebb tide)[1] at two depths (3 ft below surface and 3 ft above bottom)
Newark Bay Northeast[2]	Four times (just before low slack tide, maximum flood tide, just before high slack tide and maximum ebb tide)[1] at two depths (3 ft below surface and 3 ft above bottom)
Newark Bay Northwest[2]	Four times (just before low slack tide, maximum flood tide, just before high slack tide and maximum ebb tide)[1] at two depths (3 ft below surface and 3 ft above bottom)
Newark Bay South[2]	Four times (just before low slack tide, maximum flood tide, just before high slack tide and maximum ebb tide)[1] at two depths (3 ft below surface and 3 ft above bottom)
Second River	Once at mid-depth
Third River	Once at mid-depth
Saddle River	Once at mid-depth
Above Dundee Dam	Once at mid-depth
Hackensack River	Four times (just before low slack tide, maximum flood tide, just before high slack tide and maximum ebb tide)[1] at two depths (3 ft below surface and 3 ft above bottom)
Arthur Kill	Four times (just before low slack tide, maximum flood tide, just before high slack tide and maximum ebb tide)[1] at two depths (3 ft below surface and 3 ft above bottom)

Location	Event Sampling Strategy
Kill van Kull	Four times (just before low slack tide, maximum flood tide, just before high slack tide and maximum ebb tide)[1] at two depths (3 ft below surface and 3 ft above bottom)

[1] Four samples will be collected over the tidal cycle for the first two events. After two events are completed, the data will be evaluated for variability. Should the variability in concentrations among the four tide stages be low (i.e., 50%; to be determined in consultation with USEPA), the frequency of sampling may be reduced to high slack tide and low slack tide only.

[2] Data collected from the NB stations will be evaluated for variability. Should the variability in concentration among the stations be low, to be determined in consultation with USEPA, the number of stations may be reduced.

Table 3: Chemical Data Collection Program Sample Summary Table for Routine Events

Routine Events	Stations	Depth Intervals	Timing of Sampling					Sample Subtotals
			HW Slack	LW Slack	Max Ebb	Max Flood	Non-Tidal	
Upper River	1	2	1	1	1	1	0	8
Lower River	4	2	1	1	1	1	0	32
Newark Bay	5	2	1	1	1	1	0	40
Tributaries 3		1	0	0	0	0	1	3
Above Dundee Dam	1	1	0	0	0	0	1	1
Hackensack River	1	2	1	1	1	1	0	8
Kills 2		2	1	1	1	1	0	16
Total Samples per Survey								108
Total Routine Event Samples (Five Surveys)								**540**

Note:
HW Slack = High water slack tide
LW Slack = Low water slack tide
Max Ebb = Maximum flow during ebb tide
Max Flood = Maximum flow during flood tide

High Flow Events. The objective of the High Flow Event program is to capture data under conditions in which resuspension of contaminants from the sediment bed and subsequent deposition from the water column back to the sediment bed are expected to dominate other transport processes. A threshold for mobilization of the High Flow Event has been established as > 3,000 cfs of flow at the Dundee Dam gage, a flow with a return rate of approximately 3 months.

Subject to weather conditions, two High Flow Events are planned under storm-induced high flow (i.e., not sustained high flow) conditions (> 3,000 cfs at Dundee Dam). The high flows (exceeding 3,000 cfs) that trigger the High Flow Events are not sustained high flows, but weather-induced flows. The predicted peak discharge of a weather event should exceed the 3,000 cfs criterion to trigger an event. There is no limitation with respect to the duration of the event, but events of such magnitude may occur over the span of several days. The planned sample locations include the LPRSA (including the LPRSA tributaries), above Dundee Dam and the NBSA (QAPP Worksheet #18). The data collected during the High Flow Events will provide data to support the exposure point calculations for the RAs and FWM. The data will also be used to provide the CFT model information to preliminarily calibrate the erosion fluxes from the sediments to the water column, and the subsequent deposition of particle-bound contaminants from the water column to the sediment. It is also anticipated that during these events there will be a higher loading of suspended

sediments (i.e., more contamination on a per unit weight suspended solids basis may occur since elevated flows associated with these high flow events will resuspend more bed sediment). Up to one hundred fourteen (114) samples will be collected during each of the High Flow Events to be analyzed for target analytes as defined in QAPP Worksheet #15. Group A analytes will be measured during both events. Group B analytes will be measured in one of the two events. Shallow (3 ft below surface) water stations in the five locations in RM 0 – 17.4 of the LPR will be analyzed for pathogens (QAPP Worksheets #15 and #18). Group C analytes (coliform bacteria) and Group D analytes (*Giardia* and cryptosporidium) will be sampled during both events. Frequency and type of QC samples are provided in QAPP Worksheet #20

Stations will be co-located with the Routine Event stations (when flows > 1,000 cfs) (Table 4 and Figure 1). At the station above Dundee Dam, samples will be collected six times throughout the predicted storm hydrograph; three times on the rising limb, one near the peak, and twice on the falling limb are targeted. The LPRSA tributaries, stations in Newark Bay, Hackensack River and RM 0 – 17.4 of the LPRSA will be sampled four times throughout the predicted storm hydrograph; twice on the rising limb, one near the peak, and once on the falling limb are targeted. Samples will be collected from the Arthur Kill and Kill van Kull twice during each high flow event: at the times of predicted high water slack and low water slack tides.

Table 4: Chemical Data Collection Program Sampling Station Coordinates for High Flow Events

Location	Event Sampling Strategy
Upper River RM 10.2	Four times over the predicted storm hydrograph at two depths (3 ft below surface and 3 ft above bottom)
Lower River RM 0 RM 1.4 RM 4.2 RM 6.7	Four times over the predicted storm hydrograph at two depths (3 ft below surface and 3 ft above bottom)
Newark Bay North[1]	Four times over the predicted storm hydrograph at two depths (3 ft below surface and 3 ft above bottom)
Newark Bay East[1]	Four times over the predicted storm hydrograph at two depths (3 ft below surface and 3 ft above bottom)
Newark Bay Northeast[1]	Four times over the predicted storm hydrograph at two depths (3 ft below surface and 3 ft above bottom)
Newark Bay Northwest[1]	Four times over the predicted storm hydrograph at two depths (3 ft below surface and 3 ft above bottom)
Newark Bay South[1]	Four times over the predicted storm hydrograph at two depths (3 ft below surface and 3 ft above bottom)
Second River	Four times over the predicted storm hydrograph at mid-depth
Third River	Four times over the predicted storm hydrograph at mid-depth
Saddle River	Four times over the predicted storm hydrograph at mid-depth
Above Dundee Dam	Six times over the predicted storm hydrograph at mid-depth
Hackensack River	Four times over the predicted storm hydrograph at two depths (3 ft below surface and 3 ft above bottom)

Location	Event Sampling Strategy
Arthur Kill	Twice (just before low slack tide and just before high slack tide) at two depths (3 ft below surface and 3 ft above bottom)
Kill van Kull	Twice (just before low slack tide and just before high slack tide) at two depths (3 ft below surface and 3 ft above bottom)
[1] Data collected from the NB stations will be evaluated for variability. Should the variability in concentration among the stations be low, to be determined in consultation with USEPA, the number of stations may be reduced.	

A total of up to two hundred twenty-eight (228) samples will be collected during the two High Flow Events (Table 5). If the 3,000 cfs criterion is not met during the CWCM program, the criterion may be adjusted in consultation with the USEPA to increase the probability of achieving the flow event.

One High Flow Event will consist of sampling for Group A, Group C and Group D analytes only. The other High Flow Event will include Group A, Group B, Group C and Group D analytes. Group C and D analytes will be collected only at five locations in the lower 17.4 RM of the LPR.

Table 5: Chemical Data Collection Program Sample Summary Table for High Flow Events

High Flow Event	Stations	Depth Intervals	Timing of Sampling			Sample Subtotals
			HW Slack	LW Slack	Hydro-graph	
Upper River	1	2	0	0	4	8
Lower River	4	2	0	0	4	32
Newark Bay	5	2	0	0	4	40
Tributaries 3		1	0	0	4	12
Above Dundee Dam	1	1	0	0	6	6
Hackensack River	1	2	0	0	4	8
Kills 2		2	1	1	0	8
Total Samples per Survey						114
Total High Flow Event Samples (Two Surveys)						**228**
Note: **HW Slack = High water slack tide** **LW Slack = Low water slack tide**						

Low Flow/Spring Tide Event. Surface water monitoring during the combination of low flow and spring tide conditions will provide data during periods of maximum tidal mixing. These conditions are expected to generate the highest tidal energies when compared to other flow/tide combinations. Low flow in the LPRSA is defined as <400 cfs as measured at the Dundee Dam gage. One Low Flow/Spring Tide Event will be conducted as part of the CWCM program.

The Low Flow/Spring Tide Event is planned under low flow conditions (<400 cfs at Dundee Dam) during a spring tide. The sample locations will include the stations in the LPRSA and above Dundee Dam (QAPP

Worksheet #18). The data collected during the Low Flow/Spring Tide Event will provide additional data in the lower reaches of the river to support the exposure point calculations for the RAs and FWM. This event is planned to combine low-flow conditions with a spring tide in order to provide data to the CFT model when the highest tidal energies and tidal mixing may be occurring. Up to forty-four (44) samples will be collected during the Low Flow/Spring Tide Event to be analyzed for Group A and Group B target analytes as defined in QAPP Worksheet #15. Shallow (3 ft below surface) water stations in the five locations in RM 0 – 17.4 of the LPR will be analyzed for Group C analytes (coliform bacteria) (QAPP Worksheets #15 and #18). Group D analytes (*Giardia* and cryptosporidium) will not be sampled during the low flow/spring tide event. Frequency and type of QC samples are provided in QAPP Worksheet #20.

Nine stations, generally located at the same stations occupied in the PWCM program and Routine Event sampling, will be sampled at or near the thalweg during the Low Flow/Spring Tide Event (Table 6 and Figure 1). If the flow at Dundee Dam is < 250 cfs, the upper river station will be located at RM 13.5; if the flow is 250 – 400 cfs, the station will be located at RM 10.2. The location of two of the lower river stations (Tidal 1 and Tidal 2) will be determined within 48 hours of the time of survey based on the upstream extent of the salt wedge (Exhibit 1). One of these stations, Tidal 1, will be located approximately one mile downstream of the toe of the salt wedge. Tidal 2 will be located halfway between Tidal 1 and the station at RM 1.4 (but not upstream of RM 4.2). The discharge used to determine Tidal 1 will be based on an average of the prior 7 days discharge at Dundee Dam.

A total of up to forty-four (44) samples will be collected during the Low Flow/Spring Tide Event (Table 7). The Low Flow/Spring Tide sampling event will be conducted within a four-day period and will include Group A, Group B and Group C analytes.

Table 6: Chemical Data Collection Program Sampling Stations for Low Flow/Spring Tide Event

Location	Event Sampling Strategy
Upper River: RM 10.2 for flows > 250 cfs RM 13.5 for flows < 250 cfs	Four times (just before low slack tide, maximum flood tide, just before high slack tide and maximum ebb tide) at two depths (3 ft below surface and 3 ft above bottom)
Lower River RM 0 RM 1.4 Tidal 1 (see Exhibit 1) Tidal 2 (see Exhibit 1)	Four times (just before low slack tide, maximum flood tide, just before high slack tide and maximum ebb tide) at two depths (3 ft below surface and 3 ft above bottom)
Second River	Once at mid-depth
Third River	Once at mid-depth
Saddle River	Once at mid-depth
Above Dundee Dam	Once at mid-depth

Table 7: Chemical Data Collection Program Sample Summary Table for Low Flow/Spring Tide Event

Low Flow/Spring Tide Event	Stations	Depth Intervals	Timing of Sampling					Sample Subtotals
			HW Slack	LW Slack	Max Ebb	Max Flood	Non-Tidal	
Upper River	1	2	1	1	1	1	0	8
Lower River	4	2	1	1	1	1	0	32
Newark Bay	0	0	0	0	0	0	0	0
Tributaries 3		1	0	0	0	0	1	3
Dundee Dam	1	1	0	0	0	0	1	1
Hackensack River	0	0	0	0	0	0	0	0
Kills 0		0	0	0	0	0	0	0
Total Samples per Survey								44
Total Low Flow/Spring Tide Samples (One Survey)								**44**

Note:
HW Slack = High water slack tide
LW Slack = Low water slack tide
Max Ebb = Maximum flow during ebb tide
Max Flood = Maximum flow during flood tide

2.3 Standard Operating Procedures

The CPG has prepared a set of project-specific field SOPs for this investigation. Where possible, these SOPs were based on previous SOPs developed by Malcolm Pirnie, Inc. (MPI) and Tierra Solutions, Inc. (2007) for work conducted in the LPR and Newark Bay. These field SOPs are provided as Appendix B to the QAPP and include the following:

SOP No.	Title
LPR-G-01	Field Records
LPR-G-02 N	avigation/Positioning
LPR-G-03 Equi	pment Decontamination
LPR-G-04	Investigation Derived Waste (IDW) Handling and Disposal
LPR-G-05 Sa	mple Custody
LPR-G-06	Sample Packaging and Shipping
LPR-FI-04	Small Volume Surface Water Sampling/Chemical Data Collection
LPR-FI-05 Wa	ter Column Profiling
LPR-FI-06	Surface Water Sampling for Trace Metals

2.4 Site facilities

The field facility located at the Kelways Industrial Park in East Rutherford, NJ (at approximately RM 13.5) will serve as the base of operations for this effort. Indoor space at the facility will be used for storage, staging surveys, and packaging samples for shipment to the laboratory for analysis. The floating dock located at the field facility will be used for vessel mobilization for survey operations in the middle and upper sections of the study area. The lower portion of the LPRSA and the NBSA study area will be accessed from the Passaic Yacht Club. The station above Dundee Dam will be accessed from the public boat ramp in Elmwood Park.

2.5 Health and safety

The tasks described within this FSP Addendum will be conducted in accordance with the companion program-specific HASP Addendum prepared for this effort, in conjunction with the overall Project HASP (MPI 2005a). This program-specific HASP Addendum will be submitted as a separate document.

2.6 Data management

The data collected during the tasks described within this FSP Addendum will be handled and managed in accordance with the Lower Passaic River Restoration Project Data Management Plan (DMP) (AECOM 2010b). The DMP specifies data formats, data deliverables, and data archiving procedures.

3.0 Field activity schedule

The following schedule is proposed for the monitoring events:

Date Task	[1]
August 2011	First Routine Event (summer event)
August – September 2011	Review data from First Routine Event
September 2011 – November 2011	Low Flow/Spring Tide Event (autumn event)
December 2011 – February 2012	Winter Routine Event
March 2012 – June 2012	Two spring Routine Events Potential for High Flow Events
June 2012 – August 2012	Summer Routine Event

[1]Timing and duration of surveys dependent on weather, water temperature, and flow conditions. The USEPA will be notified of proposed timing during the planning of each of the sampling events.

4.0 Reporting

Regular reporting on the progress of the CWCM program will be performed as part of the overall monthly progress reporting for the LPR RI/FS and NBSA RI/FS and will include the following:

- Brief summary of any field surveys performed during the previous month (type of survey, dates, number of samples collected, issues of note, and deviations from the program QAPP/FSP Addendum).
- Delivery of validated data, processed data, and raw data (as applicable). Requirements for validated data submittals are prescribed by the Region 2 guidance on multimedia electronic data deliverables (EDDs) at http://www.epa.gov/region02/superfund/medd.htm.

Following completion of the entire CWCM program, a data characterization summary report will be prepared that will include the following:

- Summary of the overall monitoring effort including a full description of any deviations from this FSP Addendum or the associated QAPP;
- Presentation of a data quality review and summary of data usability;
- Summary graphics of monitoring data with a written summary on the updated interpretation of the LPR estuarine dynamics; and
- Discussion on achievement of the DQOs and any recommended follow-up investigations.

5.0 References

AECOM 2010a. Quality Assurance Project Plan/Field Sampling Plan Addendum. Remedial Investigation Water Column Monitoring/Physical Data Collection for the Lower Passaic River, Newark Bay and Wet Weather Monitoring. Lower Passaic River Restoration Project. Revision 4. March 2010.

AECOM 2010b. Lower Passaic River Restoration Project Data Management Plan. July 2010, including all revisions.

HydroQual, 2006. Final Modeling Work Plan. Lower Passaic River Restoration Project. Mahwah, NJ.

Malcolm Pirnie, Inc. (MPI) 2005a. Lower Passaic River Restoration Project. Health and Safety Plan. Prepared for US Environmental Protection Agency and US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, NY. August 2005.

MPI 2005b. Lower Passaic River Restoration Project. Work Plan. Prepared for US Environmental Protection Agency and US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, NY. August 2005.

MPI 2005c. Lower Passaic River Restoration Project. Revised Preliminary Draft Field Sampling Plan. Volume 3. Prepared for US Environmental Protection Agency and US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, NY. July 2005.

MPI 2005d. Lower Passaic River Restoration Project. Quality Assurance Project Plan. Prepared for US Environmental Protection Agency and US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, NY. August 2005.

MPI 2006. Lower Passaic River Restoration Project. Draft Field Sampling Plan. Volume 1. Prepared for US Environmental Protection Agency, US Army Corps of Engineers, and New Jersey Department of Transportation/Office of Maritime Resources. Malcolm Pirnie, Inc., White Plains, NY; Earth Tech, Inc., Bloomfield, NJ; Battelle, Stony Brook, NY. January 2006.

MPI, Earth Tech, and Battelle 2006. Lower Passaic River Restoration Project. Draft Field Sampling Plan. Volume 2. Prepared for US Environmental Protection Agency and US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, NY. June 2006.

MPI 2007. Lower Passaic River Restoration Project. Conceptual Site Model. Prepared for US Environmental Protection Agency, US Army Corps of Engineers, and New Jersey Department of Transportation/Office of Maritime Resources. Malcolm Pirnie, Inc., White Plains, NY. February 2007.

Tierra 2007. Standard Operating Procedures and Revisions. Newark Bay Study Area Phase II RIWP, Appendix F. October, 2007.

USEPA 2005. Intergovernmental Data Quality Task Force Uniform Federal Policy for Implementing Environmental Quality Systems Evaluating, Assessing, and Documenting Environmental Data Collection/Use and Technology Programs Manual Publication Numbers: EPA: EPA-505-F-03-001 DoD: DTIC ADA 395303 Final Version 2. March 2005.

USEPA 2007. Administrative Settlement Agreement and Order on Consent for Remedial Investigation/ Feasibility Study. CERCLA Docket No. 02-2007-2009. May 2007.

Windward 2009a. Lower Passaic River Restoration Project. Lower Passaic River Study Area RI/FS. Quality Assurance Project Plan: Fish and decapod crustacean tissue collection for chemical analysis and fish community survey. Final. Prepared for Cooperating Parties Group, Newark, New Jersey. Windward Environmental LLC, Seattle, WA. August 2009.

Windward 2009b. Lower Passaic River Restoration Project. Lower Passaic River Study Area RI/FS. Quality Assurance Project Plan: Surface sediment chemical analyses and benthic invertebrate toxicity and bioaccumulation testing. Final. Prepared for Cooperating Parties Group, Newark, New Jersey. October 8, 2009. Windward Environmental LLC, Seattle, WA.

Figure 1: CWCM Program Sampling Locations

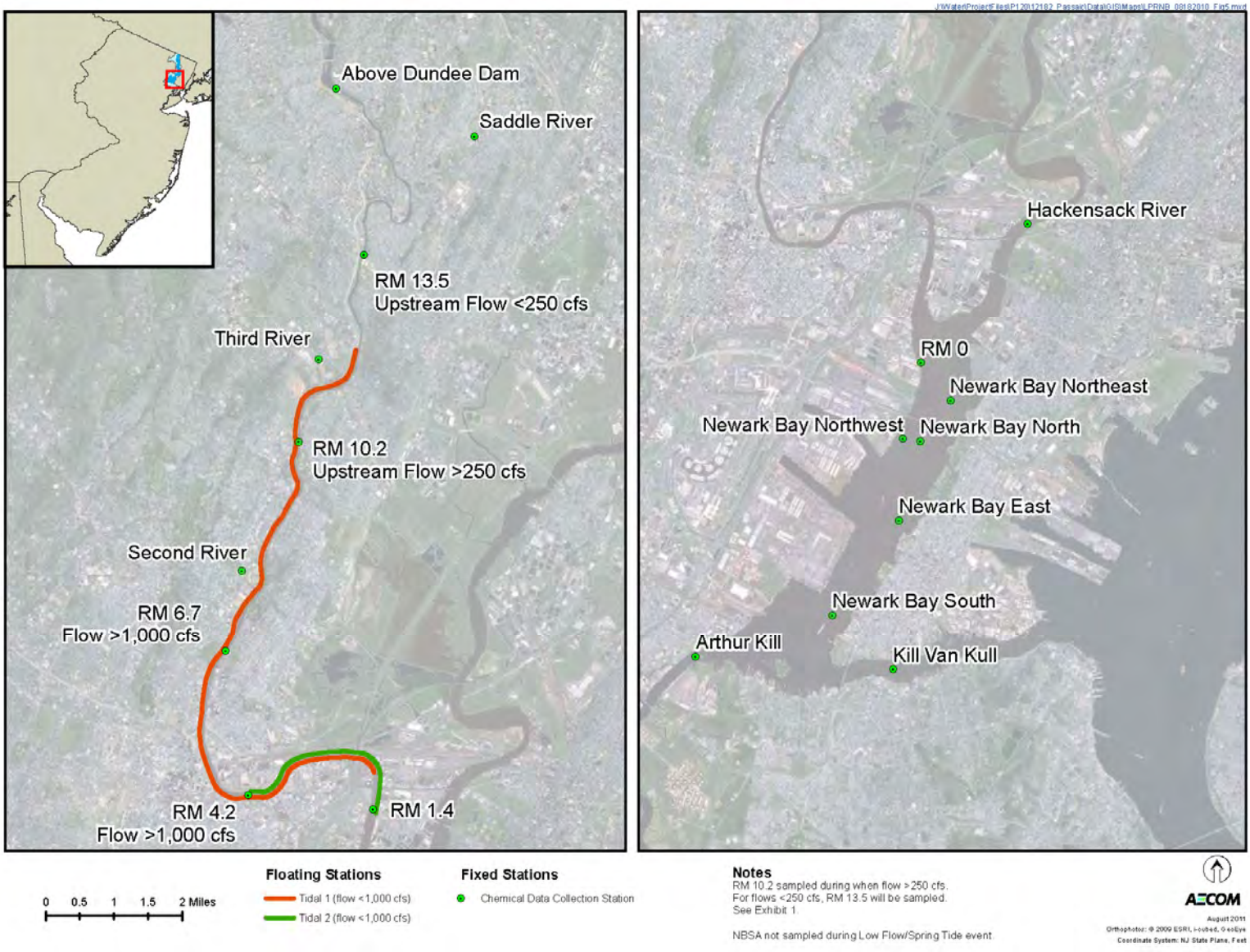


Exhibit 1. Locations of Tidal 1 and Tidal 2

The location of Tidal 1 and Tidal 2 will be determined prior to the execution of the Routine Events (when flow is <1,000 cfs at Dundee Dam) and Low Flow/Spring Tide Events. The location of Tidal 1 is intended to be approximately one mile downstream of the salt wedge, and Tidal 2 will be sampled based on the location of Tidal 1 (see below).

Within two days prior to a sampling event, the AECOM CWCM Task Manager, or designee, will coordinate with Moffat & Nichol's CFT Modeling Liaison, or designee, to estimate the discharge from Dundee Dam for the seven previous days from the USGS website and flow predictions for Dundee Dam from the NOAA website. Using these data, the tidal stage (i.e., low tide, high tide, maximum ebb tide or maximum flood tide) and the moon stage (i.e., neap to spring tide), the location for Tidal 1 will be determined. The model output for the 2 part per thousand (ppth) isohaline as a function of these properties is presented in Table E-1 and Figure E-1. Example sampling locations during neap and spring tides based on hydrodynamic model results are presented in Tables E-2 and E-3, respectively.

From the determined Tidal 1 location, Tidal 2 will be determined as follows:

- If the point halfway between Tidal 1 and RM 1.4 is located upstream of RM 4.2, Tidal 2 will be located at RM 4.2.
- If Tidal 1 is located downstream of RM 4.2, Tidal 2 will be located halfway between Tidal 1 and RM 1.4.

This information will be relayed to and confirmed with the AECOM Field Task Manager (FTM) and Ocean Surveys, Inc. (OSI), the vessel subcontractor.

Table E-1: Approximate Locations of the 2 ppth Isohaline Line

Discharge at Dundee Dam Gage (cfs)	2 ppth Isohaline Location (river miles)			
	Neap		Spring	
	High Tide	Low Tide	High Tide	Low Tide
100 12.75		11	12.5	9.25
200 11.25		9	10.75	6.75
300 10.25		7.5	9.75	5
600	8	5.75 8 3.75		
900	6.5	4 6.5 2		
1200 5.25		3.25	5.75	1
2000 3.5		1.5	4.5	0.25
3000 2		0.75	3.25	0
6000	0.75	-0.5 1.25	-1.5	
12000 -1		-1.25	-0.75	-2

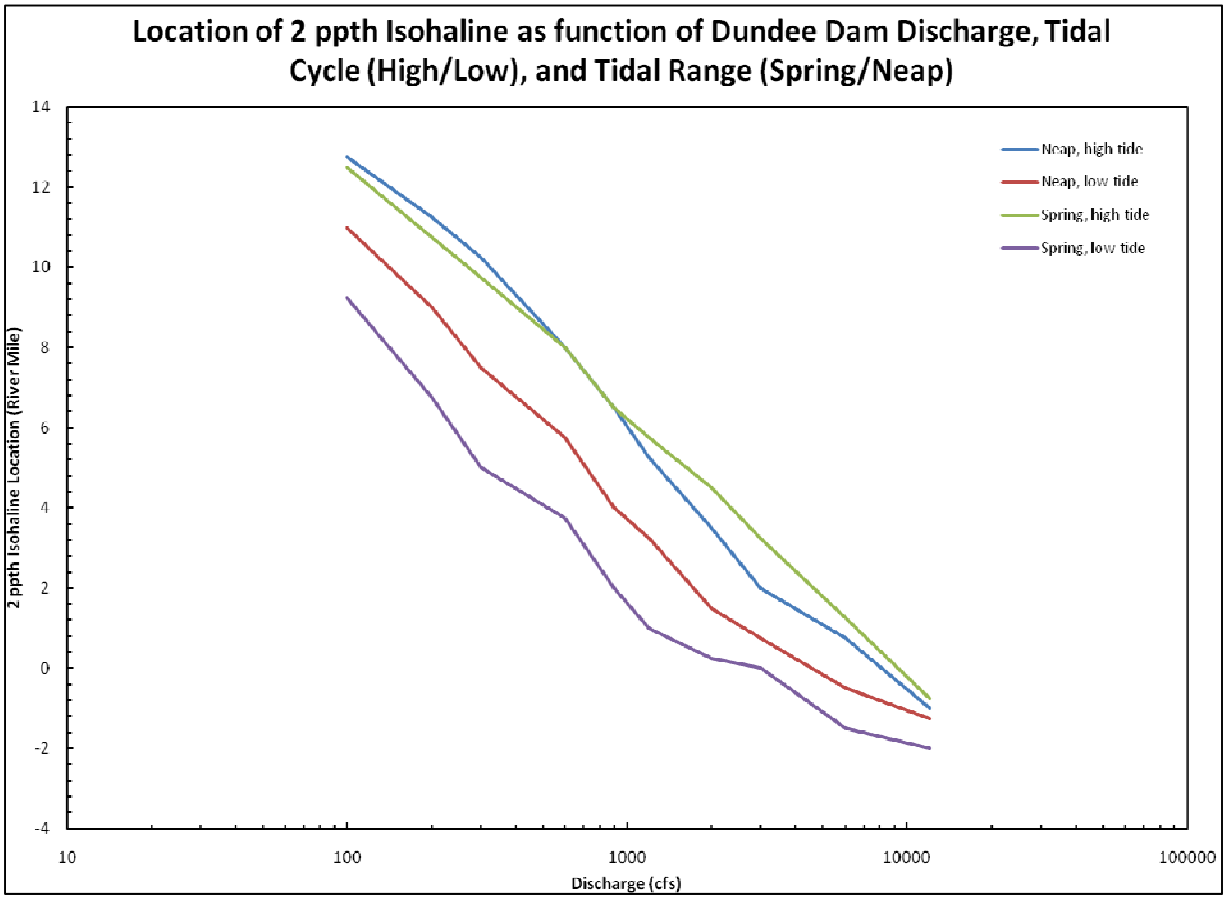

Location of 2 ppth Isohaline as function of Dundee Dam Discharge, Tidal Cycle (High/Low), and Tidal Range (Spring/Neap)
2 ppth Isohaline Location (River Mile)
14
12
10
8
6
4
2
0
-2
-4
10
100
1000
10000
100000
Discharge (cfs)
Neap, high tide
Neap, low tide
Spring, high tide
Spring, low tide

Table E-2: Example Approximate Locations of Tidal 1 and Tidal 2 during Neap Tide Conditions

Discharge (cfs)	Approximate Locations of Tidal 1 and Tidal 2 During Neap Tides							
	Tidal 1 (RM)				Tidal 2 (RM)			
	HW Slack	LW Slack	Max Ebb	Max Flood	HW Slack	LW Slack	Max Ebb	Max Flood
150	11.5 10	.5 11	.1 11	.4	4.2	4.2	4.2	4.2
250	10.4	9.0 10	.0 9	.9	4.2	4.2	4.2	4.2
500	8.8 6.	5 8.	5	7.7	4.2	4.0 4.	2 4.	2
750	7.6 5.	2 7.	2	5.7	4.2	3.3 4.	2 3.	6
1,000	6.5 3.	9 6.	2	4.2	3.9	2.6 3.	8 2.	8

Notes:
cfs = cubic feet/second
RM = river mile
HW Slack = high water slack tide
LW Slack = low water slack tide
Max Ebb = during maximum flow of outgoing (ebb) tide
Max Flood = during maximum flow of incoming (flood) tide
Actual locations to be determined within 48 hours of sampling
Discharge determined from gage at Dundee Dam.

Table E-3: Example Approximate Locations of Tidal 1 and Tidal 2 during Spring Tide Conditions

Discharge (cfs)	Approximate Locations of Tidal 1 and Tidal 2 During Spring Tides							
	Tidal 1 (RM)				Tidal 2 (RM)			
	HW Slack	LW Slack	Max Ebb	Max Flood	HW Slack	LW Slack	Max Ebb	Max Flood
150	10.8 7	.5	10.1	10.0 4	.2	4.2	4.2	4.2
250	9.6 5.	8 8.	6	8.0	4.2	3.6 4.	2 4.	2
500	7.7 3.	6 6.	9	6.2	4.2	2.5 4.	2 3.	8
750	6.4 2.	3 5.	8	5.1	3.9	1.9 3.	6 3.	3
1,000	5.7 1.	4 4.	2	4.4	3.6	1.4 2.	8 2.	9

Notes:
cfs = cubic feet/second
RM = river mile
HW Slack = high water slack tide
LW Slack = low water slack tide
Max Ebb = during maximum flow of outgoing (ebb) tide
Max Flood = during maximum flow of incoming (flood) tide
Actual locations to be determined within 48 hours of sampling
Discharge determined from gage at Dundee Dam.

Appendix B

Field Standard Operating Procedures

AECOM

Standard Operating Procedure
Lower Passaic River Restoration Project

Small Volume Surface Water Sampling/Chemical Data Collection

Procedure Number: LPR-FI-04

Revision No.: 3

Revision Date: August 2011

Prepared by

Steve Wolf
Aaron Hopkins

Laura Kelmar, Project Manager — Date: August 10, 2011

Debra L. Simmons, Project QA Manager — Date: August 10, 2011

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Standard Operating Procedure
Lower Passaic River Restoration Project
Small Volume Surface Water Sampling/Chemical Data Collection

Contents

Standard Operating Procedure
Lower Passaic River Restoration Project
Small Volume Surface Water Sampling/Chemical Data Collection

1.0 Scope and applicability

1.1 This project Standard Operating Procedure (SOP) defines the procedures for the collection of surface water samples in the Lower Passaic River Study Area and Newark Bay Study Area as part of the Lower Passaic River Restoration Project (LPRRP). This SOP addresses both vessel and shore-based sampling efforts and is restricted to standard or "small volume" sample collection. High-volume sampling techniques are beyond the scope of this SOP.

1.2 Samples will be collected for chemical, microbiological, and physical analyses. Analytes for a particular program are specified in the Quality Assurance Project Plan (QAPP).

1.3 It is assumed that the sampling activities described in this SOP will be conducted in conjunction with water column profiling (SOP LPR-FI-05) and/or surface water sampling specific to metals analyses (SOP LPR-FI-06).

1.4 The preferred method of sampling is via a pumping system using a peristaltic pump. A trigger-activated bottle sampler may be used as a contingency.

1.5 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project Quality Assurance (QA) Manager and the Task Manager and communicated to the Cooperating Parties Group (CPG) Project Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager (RPM). Deviations from this SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and safety considerations

2.1 The health and safety (H&S) considerations for the work associated with this SOP, including physical, chemical, and biological hazards are addressed in the site-specific Health and Safety Plan (HASP) and associated addendums (MPI 2005a; MPI 2005b; AECOM 2011). The major H&S considerations for the work associated with water sample collections are the marine safety aspects of the program.

2.2 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions should be part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the condition(s) is fully remedied to the satisfaction of the SSO.

3.0 Interferences

3.1 Cross-contaminations of sample may result if sample handling equipment is inadequately or improperly decontaminated. Refer to SOP LPR-G-03 for decontamination procedures.

3.2 Contamination of samples may result if samples are exposed to certain environmental conditions. Exposure to potential sources of contamination (e.g., exhaust fumes) will be minimized.

3.3 Care must be taken to avoid disturbing the bed sediment during sampling. Re-suspended bed sediments may contaminate the surface water samples.

3.4 Inappropriate sampling equipment, such as that manufactured from non-inert plastics, may contaminate samples. Using Teflon, polymer, or stainless steel sampling equipment will minimize contamination during sample collection activities.

3.5 Purging of the pump system with a minimum of three volumes of site water prior to sample collection will ensure a representative sample.

4.0 Equipment and materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Water pump (peristaltic pump capable of 10 liters/minute (L/min)or better)
- 12-volt battery (as needed)
- Electrical connectors
- CFLEX™ or equivalent polymer tubing (typical configuration requires 3/8 inch ID), a 50-foot or longer length will be required for the deepest portion of the Lower Passaic River (LPR) and Newark Bay. If tubing must be connected to create longer lengths, inert and decontaminated connectors will be used.
- Trigger-activated Teflon coated or stainless steel bottle sampler with messenger and 20 meters of graduated line
- Teflon y-connector
- Stainless steel tubing clamps
- Voss Technologies 0.45 micron inline metals filter (or equivalent)
- Pre-labeled sample containers per QAPP Worksheet #19
- Laboratory-supplied de-ionized water
- Weight bearing line/cable and anchor weight

- Field laptop computer
- Hand-held electronic recording device (optional) with Intelligent Data Entry Form® (IDEF) software from Earthsoft or equivalent
- Approved plans, including target sampling locations
- Insulated coolers with wet ice
- Field notebook, pen, standardized forms (as needed)
- Chain-of-custody forms and seals
- Chemical-free wipes
- Plastic tape
- Survey vessel fitted with differential global positioning system (DGPS) navigational equipment (SOP LPR-G-02) and fathometer
- Multi-parameter datasonde (refer to SOP LPR-FI-05)
- Safety gear (first aid kit, work vests, HASP specified personal protective equipment [PPE])
- Decontamination supplies (refer to SOP LPR-G-03 – Equipment Decontamination)

5.0 Procedu res

5.1 Equipment decontamination

The trigger-activated sampler (if used) and any non-dedicated sampling equipment will be cleaned prior to initial use and between samples at different depths and times following the Level III procedures in SOP LPR-G-03. A sufficient supply of pre-decontaminated small equipment will be mobilized to the sampling locations to minimize the need for performing field decontamination. Larger equipment, such as the trigger-activated sampler, will however require field decontamination on the vessel between samples.

5.2 Equipment Rinsate Blanks

Equipment rinsate blanks will be collected at the frequency specified in the QAPP, and from each set of sampling gear (tubing, tubing outfitted with a filter, and bottle sampler with tubing), after the sampling gear is decontaminated. Rinsate blanks of the bottle sampler will be collected by filling the decontaminated bottle sampler with laboratory-supplied de-ionized water, then filling the appropriate sample containers. Tubing rinsate blanks will be collected by pumping laboratory-supplied de-ionized water through a new length of tubing (and filter for dissolved samples) to fill the appropriate sample containers. Laboratory-specific de-ionized water will be used to prepare the rinsate blanks for each laboratory performing rinsate blank analysis. An example table is provided in Attachment 2.

5.3 Instrument Set-Up

Fasten the CFLEX™ tubing to the datasonde (YSI or equivalent) that will be used to conduct water column profiling (SOP LPR-FI-05) with plastic tape. Avoid causing any obstruction to the turbidity sensor. Attach the datasonde and the tubing inlet to the weighted deployment line at approximately 3 feet above the anchor weight. The tubing and the sensor cable should then be fastened (with plastic tape or similar) to the weighted deployment line at regular intervals over the entire length.

5.4 Water Pump

Connect the pump to a 12-volt battery or directly to the vessel's 12-volt electrical system using appropriate electrical connections. The water pumps, associated tubing, and filters should be new and dedicated to the project. The tubing using in the project will be new, dedicated tubing for each sample collected, and will be pre-cleaned and shipped bagged individually to the facility from the laboratory. The internal volume of water carried in the system (pump inlet to pump outlet) should be purged with a least three volumes of river water prior to sample collection to ensure that a representative sample is collected. The number of minutes required to purge the pump and tubing will be calculated as follows:

$(((\pi r^2 \times l)/10)/f) \times 3$ = minutes to purge the pump

Where:
π = pi
r = half the inner diameter of the tubing (cm)
l = length of tubing used on station (meters)
f = flow rate of the pump (liters/min)

5.5 Deployment/Field Data Collection

5.5.1 Navigate to the station of interest using the navigational procedures outlined in SOP LPR-G-02 – Navigational Positioning.

5.5.2 Deploy the datasonde and attached sampling tube and begin water column profiling as outlined in the QAPP and SOP LPR-FI-05.

Sample collection from a boat: Ideally, boat engines and/or generators should be shut off during sampling. If this is not possible, then the sampling platform should be positioned upwind from any running combustion engines.

At the station of interest, the datasonde (and sampling tubing) should be lowered through the water column until it is 3 feet off the bottom as determined by the shipboard fathometer. Turbidity will be monitored real time during the descent and caution taken to avoid contact with the bottom. In the event of bottom contact during sampling, as determined by operator "feel" or sporadically high real-time turbidity readings, sampling should be delayed until the turbidity plume has dissipated. Dissipation of the turbidity plume will be indicated by a return of the turbidity reading to pre-bottom contact levels.

Based on the water depth provided by the fathometer, the field team will determine the water column structure and define the desired depths for data and sample collection. After

completion of an initial water column profile by instrument retrieval, water collections will then made by returning the instrument package to the desired depth.

Metals. If required by the QAPP, metals samples will be collected following USEPA clean hands/dirty hands (CH/DH) protocols (USEPA 1996). Refer to SOP LPR-FI-06 for details of this procedure. Metals sampling will be conducted prior to the collection of other parameters.

If the program requires the collection of field-filtered dissolved parameters, water for these parameters will be collected concurrent with the total fraction. Tubing coming off the pump will be fitted with a laboratory-decontaminated Y-connector, of inert material. Lengths of Teflon-lined poly tubing will be attached to each end of the Y-connector, one length of tubing will be fitted with a Voss capsule (Catalog number: GWC-45-EA-R), or equivalent, laboratory-cleaned 0.45 micron filter. Clamps will be used on the tubing to cut off flow to either end such that water may flow for total metals or through the filter for dissolved metals. The clamp for the dissolved metals tubing will be located upflow of the filter to prevent pressure on the filter while the total metals sample bottles are being filled. The preserved bottles for total metals and dissolved metals will be filled, alternating approximately 25% of volume, until full. This will continue for other parameters that require the collection of total and dissolved samples, such as mercury. Should the inline filter clog, a new 0.45 filter will be placed on the tubing, and that filter purged for 10 seconds prior to resuming sampling.

Other constituents. After filling the sample containers for metals and dissolved analyses at the required depth, the field team will sample for the remaining constituents. Turbidity readings will be monitored throughout the pump deployment; in the event of contact with the bottom, the tubing will be retrieved and redeployed up-current of the turbidity plume or sampling will be suspended until after the plume has dissipated. Bottles will be filled sequentially, starting with volatile organic compounds and working in order of decreasing volatility.

If sampling requires use of a trigger-activated sampling device (e.g., loss of power on the vessel), the field team will lower the 2-L sample bottle to the appropriate depth. Turbidity readings will be monitored throughout the bottle sampler deployment; in the event of contact with the bottom, the sampler will be retrieved and redeployed up-current of the turbidity plume or sampling will be suspended until after the plume has dissipated to pre-contact levels. The sampler will then be retrieved to the boat deck, a new section of CFLEX™ tubing will be attached to the outlet, and samples will be collected directly from the tubing. Bottles will be filled sequentially, starting with volatile organic compounds and working in order of decreasing volatility. During the subsampling from the bottle sampler, the field team will take care to remove all residual solids from the sampling device for inclusion in the samples. Following collection of volatile compounds, the device will be continually "swirled" to keep solids in suspension during sampling. If necessary, some sample from an unpreserved bottle will be poured back into the bottle sampler to "swirl and rinse out" solids that may cling to the sidewalls of the sampling device. As needed, the bottle sampler will be redeployed to fill all bottles necessary per QAPP Worksheet #19.

Sample collection from a bridge or shore point: At the station of interest, the field team will lower the datasonde (and sampling tubing) through the water column until the probes and tubing inlet are completely submerged and at least 3 inches below the water surface

and record in-situ parameters according to SOP LPR-FI-05. If the instrument package makes contact with the bottom sampling should be delayed for 5 minutes to allow for any suspended sediments to dissipate to pre-contact levels as determined by monitoring real-time turbidity readings. Sample collection can then proceed as outlined for boat-based sample collection using pumps or sampler deployment if necessary. If sample collection through direct immersion is possible and appropriate, samples will be collected by lowering a capped, inverted sample bottle beneath the water surface, uncapping while submerged, and then slowly rotating the bottle upright until full. The bottle will then be capped while submerged and removed from the water column. Samples that require collection into pre-preserved bottles will be collected using an interim container (for example, a non-preserved laboratory-supplied bottle of a material appropriate for the analysis) and then transferred into the pre-preserved bottle.

All samples will be collected into bottles that were received pre-preserved (QAPP Worksheet #19) or will be preserved upon receipt at the laboratory.

5.5.3 Sample collection information will be recorded at the time of collection using either IDEFs, standardized forms, the field logbook, or a combination. This information will include, but not be limited to, the station ID, sample ID, time and date of sample collection, sample collection depth, the sampler's name, vessel, description of any sample processing, and any pertinent observations. An example of the IDEF is provided as Attachment 1. Refer to QAPP Worksheet #27 for sample identification details.

5.5.4 Samples will be placed in coolers and stored on ice (refer to the QAPP for containerization and storage specifications) until shipment to the laboratory. Chlorophyll a samples (if required for the program) will immediately be placed in the dark and on ice.

5.5.5 Sample custody, packaging and shipment will be conducted according to the procedures described in SOPs LPR-G-05 – Sample Custody, and LPR-G-06 – Packaging and Shipping.

6.0 Quality Assurance / Quality Control

6.1 Entries on the forms and in the field logbook will be checked by the samplers to verify that the information is correct.

6.2 It is the responsibility of the Field Task Manager (FTM) or designee to spot check adherence to the procedural requirements of this SOP and to review the associated documentation for accuracy and completeness.

6.3 Data quality evaluations will be based on quality control (QC) sample results. QC samples may include field duplicates, matrix spike/matrix spike duplicate (MS/MSD) samples and equipment rinsate blanks; frequency of collection requirements is tabulated in QAPP Worksheet #28. Additional volume for field duplicates and MS/MSD samples will be collected according to the methods outlined in this SOP; however, with the exception of volatile compounds, bottles will be filled concurrently (rather than sequentially) if possible to minimize variability between sample containers.

7.0 Data and records management

7.1 Field records will be generated and maintained as outlined in SOP LPR-G-01 – Field Records and in the LPR Data Management Plan (DMP) [AECOM 2010, or current version]. These documents cover all aspects of collection including chronology of events, station locations, time/date, sampler name, and data collected.

7.2 Field data will be maintained and distributed to the appropriate personnel as described in the LPR DMP (AECOM 2010, or current revision).

7.3 Deviations to the procedures detailed in the SOP must be recorded in the field logbook at the time of occurrence and summarized on the Daily Activity Log (refer to SOP LRP-G-01 – Field Records). A formal nonconformance report (NCR) will be completed (refer to SOP LRP-G-01 – Field Records) and distributed as specified in the QAPP.

7.4 All records associated with the activities described in this SOP will be ultimately maintained in accordance with the Lower Passaic River Quality Management Plan (AECOM 2009).

8.0 Personnel qualifications and training

The individuals executing these procedures must have read, and be familiar with, the requirements of this SOP and the corresponding LPRRP plans (e.g., HASP, QAPP, DMP, and FSP). Water quality data collection is a relatively simple procedure requiring minimal training. However, inexperienced personnel performing these activities will be initially be supervised by the FTM or designee.

9.0 Ref erences

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-207-2009. September 2009 or current version.

AECOM 2010. Lower Passaic River Data Management Plan. July 2010 or current version.

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011 or current version.

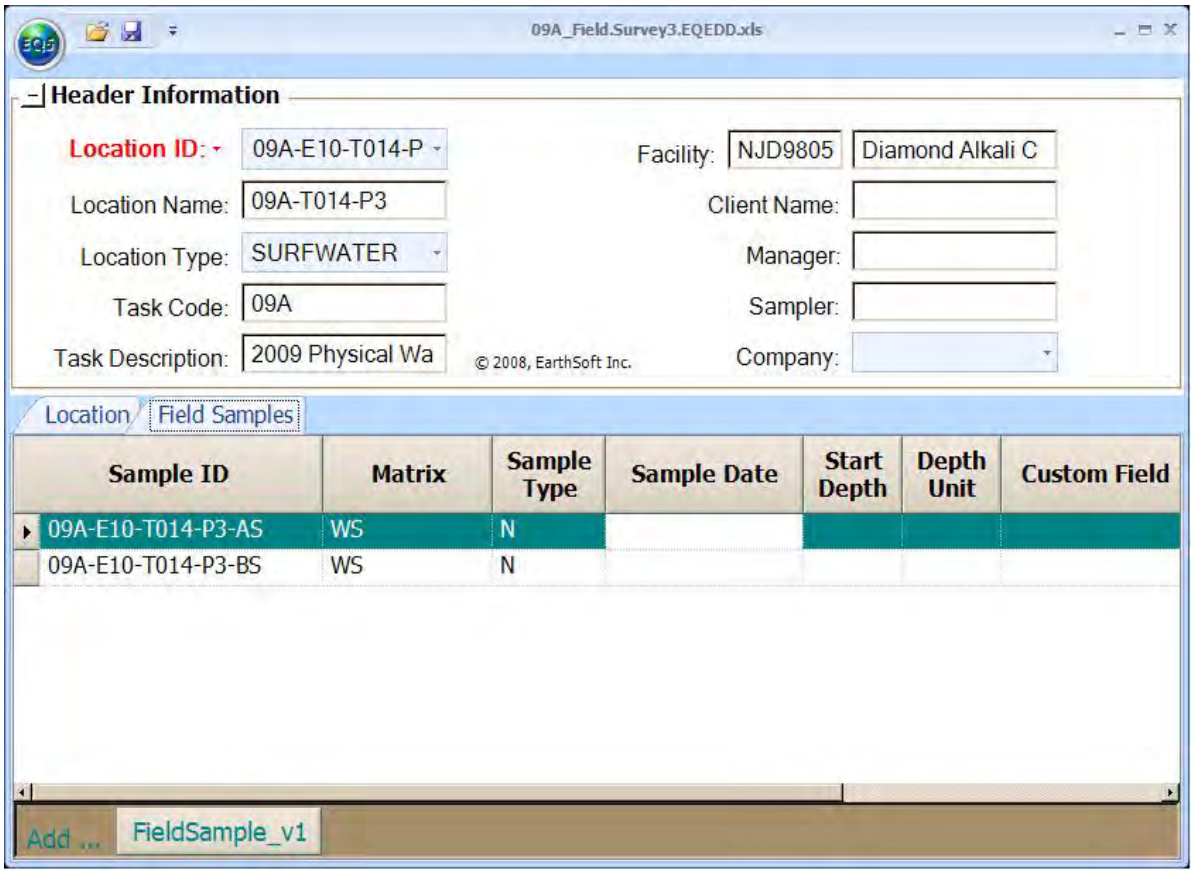
MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

USEPA 1996. Method 1669 Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels. July 1996.

10.0 Revision history

Revision	Date	Changes
0	June 2010	NA
1	September 2010	Minor revisions throughout document
2	July 2011	Minor revisions throughout document
3	August 2011	Minor revisions; update to dissolved parameter collection; equipment blank table added as Attachment 2

Attachment 1. Example of IDEF



Attachment 2. Example Table of Laboratories and Equipment Blanks

Laboratory	Analyses Requiring De-ionized Water for Blanks
Analytical Perspectives, Wilmington, NC	Polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofurans
Columbia Analytical Services (CAS), Kelso, WA	VOCs, metals, dissolved metals, titanium, butyltins, ammonia-N, TKN, total phosphorus, total organic carbon, chlorophyll a, cyanide, total sulfide, suspended sediment concentration, total dissolved solids, alkalinity, sulfate, chloride
TestAmerica (TA), Knoxville, TN	Polycyclic aromatic hydrocarbons, Polychlorinated biphenyl congeners and homologs
CAS, Phoenix, AZ	Particulate organic carbon, dissolved organic carbon
TA, Pittsburgh, PA	Semivolatile organic compounds
CAS, Rochester, NY	Hexavalent chromium
Brooks Rand, Seattle, WA	Mercury, dissolved mercury, methylmercury, dissolved methylmercury
TA, West Sacramento, CA	Pesticides
Note: Example table is for 2011-2012 small volume chemical water column monitoring program. Additional parameters may be included in other tasks of the LPRRP. Alternative laboratories may be used with USEPA approval. Laboratories may combine blank water between laboratory locations (e.g., all TestAmerica blank water from one source).	

Standard Operating Procedure
Lower Passaic River Restoration Project

Water Column Profiling

Procedure Number: LPR-FI-05

Revision No.: 2

Revision Date: July 2011

Prepared by

Steve Wolf
Aaron Hopkins

Laura Kelmar, Project Manager — Date: July 7, 2011

Debra L. Simmons, Project QA Manager — Date: July 7, 2011

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Standard Operating Procedure
Lower Passaic River Restoration Project
Water Column Profiling

Contents

1.0 Scope and applicability

1.1 This project Standard Operating Procedure (SOP) defines the procedures for the collection of water column profile data in the Lower Passaic River Study Area and the Newark Bay Study Area as part of the Lower Passaic River Restoration Project (LPRRP) using a multi-parameter datasonde from a boat or other sampling platform.

1.2 This SOP assumes that water column profiling is associated with surface water sample/data collection activities; refer to SOPs LPR-FI-04 and LPR-FI-06, or as specified in the Quality Assurance Project Plan (QAPP).

1.3 This SOP has been prepared based on the use of a YSI™ 6820 V2, but an equivalent instrument can be used and the principles of this SOP applied to its use.

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project Quality Assurance (QA) Manager and the Task Manager and communicated to the Cooperating Parties Group (CPG) Project Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager (RPM). Deviations from this SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and safety considerations

2.1 The health and safety (H&S) considerations for the work associated with this SOP, including physical, chemical, and biological hazards are addressed in the site-specific Health and Safety Plan (HASP) and associated addendums (MPI 2005a; MPI 2005b; AECOM 2011). The major H&S considerations for the work associated with water column data collections are the marine safety aspects of the program.

2.2 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

3.1 Ensuring that the in-situ sensors are and clean will reduce interference risks. Floating debris may foul the instrumentation and regular checking during measurements is needed to ensure that sensors are not blocked.

3.2 Ensuring that the in-situ sensors are maintained properly will help reduce interference risks related to these data collection efforts and also prevent sensors from becoming corroded.

3.3 Proper calibration of the instrument is necessary to ensure accurate data. Refer to Section 5.2 of this SOP for calibration procedures.

4.0 Equipment and materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Multiparameter datasonde with turbidity sensor (YSI™ 6820 V2 or equivalent)
- EcoWatch™ data logging software or equivalent
- Connective (serial) cabling
- Sufficient memory capacity for the survey
- Weight bearing line/cable and anchor weight. Greater than 50 feet of line may be required for the deepest areas of Newark Bay.
- Field laptop computer
- Calibration solutions
- Chemical-free wipes
- Tap water supply
- Plastic tape
- Approved plans, including target locations
- Manufacturer's operating manual
- Replacement batteries
- Survey vessel fitted with differential global positioning system (DGPS) navigational equipment (SOP LPR-G-02) and a fathometer
- Safety gear (work vests, HASP specified personal protective equipment [PPE])

5.0 Procedures

5.1 Datasonde Instrument Set-Up

Fasten the pump tubing for water sample collection (SOP LPR-FI-04) to the multiparameter datasonde, avoiding any obstruction to the turbidity sensor. Attach the datasonde and the tubing inlet to the weighted deployment line at approximately 3 feet (ft) above the anchor weight. The tubing and the sensor cable should then be fastened (with cable ties) to the weighted deployment line at regular intervals over the entire length. Sensors should be inspected for cleanliness and to ensure they are free of corrosion.

Install the instrument batteries and data logging software according to the instrument-specific operating manual. A new logging file should be created for each profile to aid in data tracking. Refer to QAPP Worksheet #27 for the profile naming conventions. The data logging system should then be set up to log data every second unless otherwise specified in the QAPP.

5.2 Calibration

The datasonde should be calibrated daily before initiating water column profile data collection according to Section 2.6 of the manufacturer's operation manual (YSI 2009).

5.3 Deployment/Field Data Collection

5.3.1 Navigate to the station of interest using the navigational procedures outlined in SOP LPR-G-02 – Navigational Positioning.

5.3.2 Deploy the datasonde and attached sampling tube and begin water column data profiling as outlined in the QAPP.

Profile collection from a boat: At the station of interest, the datasonde (and sampling tubing) should be lowered through the water column until it is 3 ft off the bottom as determined by the shipboard fathometer. If the operator "feels" the bottom with the weight, the instrument should be raised and data collection delayed to allow any resuspended sediment to dissipate as determined by monitoring real-time turbidity readings. The anchor weight should be kept suspended above the bottom sediment. Based on the water depth provided by the datasonde, field technicians will determine the water column structure and define the desired depths for data and sample collection. The datasonde should be allowed to equilibrate at bottom depth for at least one minute (or until readings for all parameters stabilized) before beginning profiling.

Field technicians will then create a new logging file for that station/profile according to QAPP naming conventions (QAPP Worksheet #27) and initiate data logging. The datasonde will then be slowly retrieved by hand at a rate of approximately one foot per second, per the manufacturer's specifications for the response time of the sensors, as indicated by the real-time display in EcoWatch™. Fixed point measurements will be collected at each sampling depth. Once the initial profile is complete field technicians will return the instrument package to the sampling point and conduct water sampling according to SOP LPR-FI-04. The datasonde will continue to log data throughout the sampling activity.

After the conclusion of all sampling at a station a second profile will be collected in the same manner as the first in order to document any changes in the water column.

Profile collection from a bridge or shore point: At the station of interest, the field team should lower the datasonde (and sampling tubing) through the water column until the probes and tubing inlet are completely submerged and at least 3 inches below the water surface. If the instrument package makes contact with the bottom profiling should be delayed for 5 minutes to allow for any suspended sediments to dissipate as confirmed by monitoring real-time turbidity readings. The datasonde should be allowed to equilibrate at sample depth for at least one minute (or until readings for all parameters stabilized) before beginning profiling.

Field technicians will then create a new logging file for that station/profile according to QAPP naming conventions (Worksheet #27) and initiate data logging. Due to the shallow water depth at bridge sampling stations (1-2 ft), data will only be collected at a single depth for in-situ parameters as defined in QAPP Worksheet #18. Once the initial in-situ measurements are complete field technicians will conduct water sampling according to SOP LPR-FI-04. Data logging will continue for the duration of sampling activities in order to document any changes in the water column.

6.0 Quality assurance / quality control

6.1 It is the responsibility of the Field Task Manager (FTM) or designee to check the instrument calibration/test information, to spot check adherence to the procedural requirements of this SOP, and to review the associated documentation for accuracy and completeness.

6.2 Newly acquired profile data should be reviewed for reasonableness by the FTM or designee before moving off station.

7.0 Data and records management

7.1 Field records will be generated and maintained as outlined in SOP LPR-G-01 – Field Records and in the Lower Passaic River (LPR) Data Management Plan (DMP) [AECOM 2010, or current version]. These documents cover all aspects of collection including chronology of events, station locations, time/date, sampler name, and data collected.

Instrument check/test records including sensor calibration records will be maintained in the field logbook.

7.2 During water column profiling in-situ data will be captured on a laptop PC using EcoWatch™ data acquisition software. In addition, field technicians will record profile information on the In-situ Data Log, Attachment 1 to this SOP. Acquired data will be downloaded on a daily basis as an EcoWatch™ file and then exported as an excel spreadsheet to the AECOM Data Management Task Manager at the conclusion of the survey for permanent storage as specified in the DMP (AECOM 2010, or current version).

Data files recorded by the instrument will be tracked by date/time stamp and profile naming convention (refer to QAPP Worksheet #27). The field laptop time/clock should be checked at the start of the survey against an accurate source (e.g., cell phone or DGPS time stamp) to ensure accurate time synchronization for these tidally sensitive data.

7.3 Field data will be maintained and distributed to the appropriate personnel as described in the LPR DMP (AECOM 2010, or current revision).

7.4 Deviations to the procedures detailed in the SOP must be recorded in the field logbook at the time of occurrence and summarized on the Daily Activity Log (refer to SOP LRP-G-01 – Field Records). A formal nonconformance report (NCR) will be completed (refer to SOP LRP-G-01 – Field Records) and distributed as specified in the QAPP.

7.5 All records associated with the activities described in this SOP will be ultimately maintained in accordance with the Lower Passaic River Quality Management Plan (AECOM 2009).

8.0 Personnel qualifications and training

The individuals executing these procedures must have read, and be familiar with, the requirements of this SOP and the corresponding LPRRP plans (e.g., HASP, QAPP, DMP, and FSP). Water quality data collection is a relatively simple procedure requiring minimal training. However, initial instrument calibration and sample/data collections should be supervised by the FTM or designee.

9.0 References

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-207-2009. September 2009 or current version.

AECOM 2010. Lower Passaic River Data Management Plan. July 2010 or current version.

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011 or current version.MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

YSI 2009. 6-Series Multiparameter Water Quality Sondes. September 2009 or current version. http://www.ysi.com/resource-library.php

10.0 Revision history

Revision Date		Changes
0 June	2010	NA
1	September 2010	Minor revisions throughout document
2	July 2011	Minor revisions throughout document

Attachment 1. In Situ Data Log

Program: _____ ***Survey Name***_____

Recorded By: _____ ***Survey Date***_____

Location/Profile Time*	**EST__EDST__**		**File Name(s)**	**Comment**
	Start	**End**		

*Record as 24-hour; Check either Eastern Standard Time or Eastern Daylight Savings Time (EST/EDST).

AECOM

Standard Operating Procedure
Lower Passaic River Restoration Project

Surface Water Sampling for Trace Metals

Procedure Number: LPR-FI-06

Revision No.: 3

Revision Date: August 2011

Prepared by

Kristen Durocher
Aaron Hopkins

Laura Kelmar, Project Manager

Date: August 10, 2011

Debra L. Simmons, Project QA Manager

Date: August 10, 2011

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Standard Operating Procedure
Lower Passaic River Restoration Project
Surface Water Sampling for Trace Metals

Contents

1.0 Scope and applicability

1.1 This project Standard Operating Procedure (SOP) defines the procedures for the collection of surface water samples in the Lower Passaic River Study Area and the Newark Bay Study Area as part of the Lower Passaic River Restoration Project (LPRRP) using clean hands/dirty hands (CH/DH) protocols (USEPA, 1996). Sampling will be conducted from a boat or other sampling platform.

1.2 Samples will be collected for chemical analyses. Use of this SOP is restricted to metals, including but not limited to low-level mercury, methylmercury and hexavalent chromium. Analytes for a particular program are specified in the Quality Assurance Project Plan (QAPP).

1.3 It is assumed that the sampling activities described in this SOP will be conducted in conjunction with water column profiling (SOP LPR-FI-05) and/or surface water sampling for other parameters (SOP LPR-FI-04).

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project Quality Assurance (QA) Manager and the Task Manager and communicated to the Cooperating Parties Group (CPG) Project Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager (RPM). Deviations from this SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and safety considerations

2.1 The health and safety (H&S) considerations for the work associated with this SOP, including physical, chemical, and biological hazards are addressed in the site-specific Health and Safety Plan (HASP) and associated addendums (MPI 2005a; MPI 2005b; AECOM 2011). The major H&S considerations for the work associated with water sample collection are the marine safety aspects of the program.

2.2 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

3.1 Contamination during sampling activities can affect the accurate determination of total and dissolved metals at trace levels. Potential sources of contamination include metallic sampling equipment, deionized water, and dust from automobile/boat exhaust, cigarette smoke, nearby roads, and bridges (USEPA 1996). Adherence to the CH/DH procedures as described in Section 5.0 will minimize these interferences.

3.2 Cross-contamination of samples may result if sample handling equipment is inadequately or improperly decontaminated. Refer to SOP LPR-G-03 for decontamination procedures.

3.3 Care must be taken to avoid disturbing the bed sediment during sampling. Re-suspended bed sediments may contaminate the surface water samples.

3.4 High sample turbidity may cause clogging of the filter membrane and cause a decrease in filter efficiency/rate. Monitoring of flow rate is recommended; if a significant decrease is noted, replacement of the filter may be needed.

3.5 Purging the pump system with a minimum of three volumes of site water will ensure that the sample collected is representative of the sample location and desired depth.

4.0 Equipment and materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Water pump (peristaltic pump capable of 10 liters/minute (L/min) or better)
- 12-volt battery (as needed)
- Electrical connectors
- Laboratory-supplied pre-cleaned and double-bagged CFLEX™ or equivalent polymer tubing (typical configuration requires 3/8 inch ID), a 50-foot length will be required for the deepest portion of the Lower Passaic River (LPR). Greater than 50 feet of tubing may be required for deep samples. If tubing must be connected to create longer lengths, inert and decontaminated connectors will be used.
- Pre-cleaned and double-bagged Voss Technologies 0.45 micron inline metals filter (or equivalent)
- Teflon Y-connectors
- Stainless steel tubing clamps
- Laboratory-supplied double-bagged water sample containers per QAPP Worksheet #19
- Weight bearing line/cable and anchor weight

- Field laptop computer, equipped with Intelligent Data Entry Form® (IDEF) software or equivalent (optional)
- Approved plans, including target sampling locations
- Insulated coolers with wet ice
- Field notebook, pen, standardized forms (as needed)
- Chain-of-custody forms and seals
- Chemical-free wipes
- Plastic tape
- Zipper-lock bags
- Laboratory supplied reagent water
- Tap water supply
- Pre-cleaned pipets
- Survey vessel fitted with differential global positioning system (DGPS) navigational equipment (SOP LPR-G-02) and a fathometer
- Safety gear (first aid kit, work vests, HASP specified personal protective equipment [PPE])

5.0 Procedu res

5.1 Instrument Set-Up

Fasten the CFLEX™ tubing to the datasonde that will be used to conduct water column profiling (SOP No.: LPR-FI-05) with small cable ties. Avoid causing any obstruction to the turbidity sensor. Attach the datasonde and the tubing inlet to the weighted deployment line at approximately 3 feet (ft) above the anchor weight. The tubing and the sensor cable should then be fastened (with cable ties or similar) to the weighted deployment line at regular intervals over the entire length.

5.2 Water Pump

Connect the pump to a 12-volt battery or directly to the vessel's 12-volt electrical system using appropriate electrical connections. The water pumps, associated tubing, and filters should be new and dedicated to the project. Tubing and filters are received pre-cleaned from the laboratory and will be kept in sealed zip-top plastic bags prior to use. New tubing and filters will be used for each sample. Water pumps should be rinsed with tap water before and after each sampling day in accordance with SOP LPR-G-03. Rinsing is not generally required for the sampling apparatus (pump, datasonde etc.) between stations (or between sampling depths). However, the internal volume of water carried in the system (pump inlet to pump outlet) should be purged with a least three volumes of river water to ensure that a representative sample is collected. Prior to sampling, the tubing shall be rinsed with site water.

5.3 Equipment Rinsate Blanks

Equipment rinsate blanks will be collected at the frequency specified in the QAPP, and from each set of sampling gear (tubing and tubing outfitted with a filter) after the sampling gear is decontaminated. Rinsate blanks will be collected by pumping laboratory-supplied reagent water through a pre-cleaned (by the laboratory) length of tubing (and filter for dissolved samples) to fill the appropriate sample containers. Laboratory-specific reagent water will be used to prepare the rinsate blank for each laboratory performing rinsate blank analysis.

5.4 Sample Bottles

The laboratory will supply pre-cleaned Fluorinated Ethylene Propylene (FEP), Polytetrafluoroethylene (PTFE), conventional or linear polyethylene, polycarbonate, or polypropylene sample containers with lids in double zip top plastic bags. Bottles for low-level mercury (Hg) analysis should be fluoropolymer or glass. The containers will be rinsed with a 0.1% Hydrogen Chloride (HCl) (v/v) solution and then filled with reagent water by the laboratory prior to shipment to the field facility.

5.5 Deployment/Field Data Collection

5.5.1 Navigate to the station of interest using the navigational procedures outlined in SOP LPR-G-02 – Navigational Positioning.

5.5.2 Deploy the datasonde and attached sampling tube and begin water column profiling and sampling as outlined in the QAPP and SOPs LPR-FI-04 and LPR-FI-05. Ideally, boat engines and/or generators should be shut off during sampling. If this is not possible, then the sampling platform should be positioned upwind from any running combustion engines.

Prior to filling any bottles for metals analysis one member of the field team will be designated as the DH sampler and one member of the team will be designated as the CH sampler. The DH sampler will handle the outer sample bags and operate the pump and all other equipment during the sampling process. The CH sampler will don new nitrile gloves and only contact the inner sample bags, sample containers, filters, and sample tubing until sampling is complete.

Once the pump has been purged according to SOP LPR-FI-04 and the sample is ready to be collected, the DH sampler will open the outer bag of the appropriate sample container and allow the CH sampler to remove the inner bag and bottle. The CH sampler should take care not to contact the outer surface of the outer bag. The CH will then open the inner bag, remove the bottle, and uncap the bottle for sample collection directly from the sample tubing (the CH sampler should take care to minimize the amount of time the bottle is open to reduce the potential for atmospheric contamination). Once the required volume is collected the process is reversed to return the bottle to the inner and outer bags.

Bottles may be received pre-preserved from the laboratory using the preservatives appropriate for each analysis, as presented in Worksheet #19 of the QAPP. If bottles are not pre-preserved, preservative will be added to the sample bottles once filled with site water, and the bottle will be inverted to ensure mixing. The preservatives for each metal are as follows:

- Methylmercury: sulfuric acid
- Hexavalent chromium: laboratory-provided buffer solution
- Mercury: bromine chloride

- Other TAL metals and titanium: nitric acid

If the program requires the collection of field-filtered dissolved metals, water for these parameters will be collected concurrent with the total metals. Tubing coming off the pump will be fitted with a laboratory-decontaminated Y-connector, of inert material. Lengths of Teflon-lined poly tubing will be attached to each end of the Y-connector, one length of tubing will be fitted with a Voss capsule (Catalog number: GWC-45-EA-R), or equivalent, laboratory-cleaned 0.45 micron filter by the CH sampler. Clamps will be used on the tubing to cut off flow to either end such that water may flow for total metals or through the filter for dissolved metals. The clamp for the dissolved metals tubing will be located upflow of the filter to prevent pressure on the filter while the total metals sample bottles are being filled. The preserved bottles for total mercury and dissolved mercury will be filled, alternating approximately 25% of volume, until full. The DH sampler will operate the pump and clamps. This will continue for other parameters that require the collection of total and dissolved samples, such as methylmercury and TAL metals. Should the inline filter clog, a new 0.45 filter will be placed on the tubing, and that filter purged for 10 seconds prior to resuming sampling.

High sample turbidity may cause clogging of the filter membrane and a decrease in filter efficiency/rate. If the rate of flow is observed to decrease substantially, then it is recommended that the filter be replaced by the CH sampler by first removing the tubing outlet from the sample container. The DH sampler should then turn off the pump, reverse the pump direction, turn the pump back on to release pressure in the filter, turn the pump off again, and finally remove the used filer. A new filter can then be installed and purged as described above.

All samples will be collected into bottles that were received pre- preserved (QAPP Worksheet #19) or will be preserved upon receipt at the laboratory.

5.5.3 Sample collection information will be recorded at the time of collection using either IDEFs, standardized forms, the field logbook, or a combination. This information will include, but not be limited to, the station ID, sample ID, time and date of sample collection, sample collection depth, the sampler's name, vessel, description of any sample processing, and any pertinent observations. An example of the IDEF is provided as Attachment 1. Refer to QAPP Worksheet #27 for sample identification details.

5.5.4 Samples will be placed in coolers and stored on ice (refer to QAPP Worksheet #19 for containerization and storage specifications) until shipment to the laboratory.

5.5.5 Sample custody, packaging and shipment will be conducted according to the procedures described in SOPs LPR-G-05 – Sample Custody, and LPR-G-06 – Packaging and Shipping.

6.0 Quality assurance / quality control

6.1 Entries on the forms and in the field logbook will be checked by the samplers to verify that the information is correct.

6.2 It is the responsibility of the Field Task Manager (FTM) or designee to spot check adherence to the procedural requirements of this SOP, and to review the associated documentation for accuracy and completeness.

6.3 Data quality evaluations will be based on quality control (QC) sample results. QC samples may include field duplicates, matrix spike/matrix spike duplicate (MS/MSD) samples, and equipment rinsate blanks; frequency of collection requirements is tabulated in QAPP Worksheet #28. Additional volume for field duplicates and MS/MSD samples will be collected according to the methods outlined in this SOP; however, bottles will be filled concurrently (rather than sequentially) if possible to minimize variability between sample containers.

7.0 Data and records management

7.1 Field records will be generated and maintained as outlined in SOP LPR-G-01 – Field Records and in the LPR Data Management Plan (DMP) [AECOM 2010]. These documents cover all aspects of collection including chronology of events, station locations, time/date, sampler name, and data collected.

7.2 Field data will be maintained and distributed to the appropriate personnel as described in the LPR DMP (AECOM 2010).

7.3 Deviations to the procedures detailed in the SOP must be recorded in the field logbook at the time of occurrence and summarized on the Daily Activity Log (refer to SOP LRP-G-01 – Field Records). A formal nonconformance report (NCR) will be completed (refer to SOP LRP-G-01 – Field Records) and distributed as specified in the QAPP.

7.4 All records associated with the activities described in this SOP will be ultimately maintained in accordance with the Lower Passaic River Quality Management Plan (AECOM 2009).

8.0 Personnel qualifications and training

The individuals executing these procedures must have read, and be familiar with, the requirements of this SOP and the corresponding LPRRP plans (e.g., HASP, QAPP, DMP, and FSP). Inexperienced personnel performing these activities will be initially be supervised by the FTM or designee.

9.0 Ref erences

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-207-2009. September 2009 or current version.

AECOM 2010. Lower Passaic River Data Management Plan. July 2010 or current version.

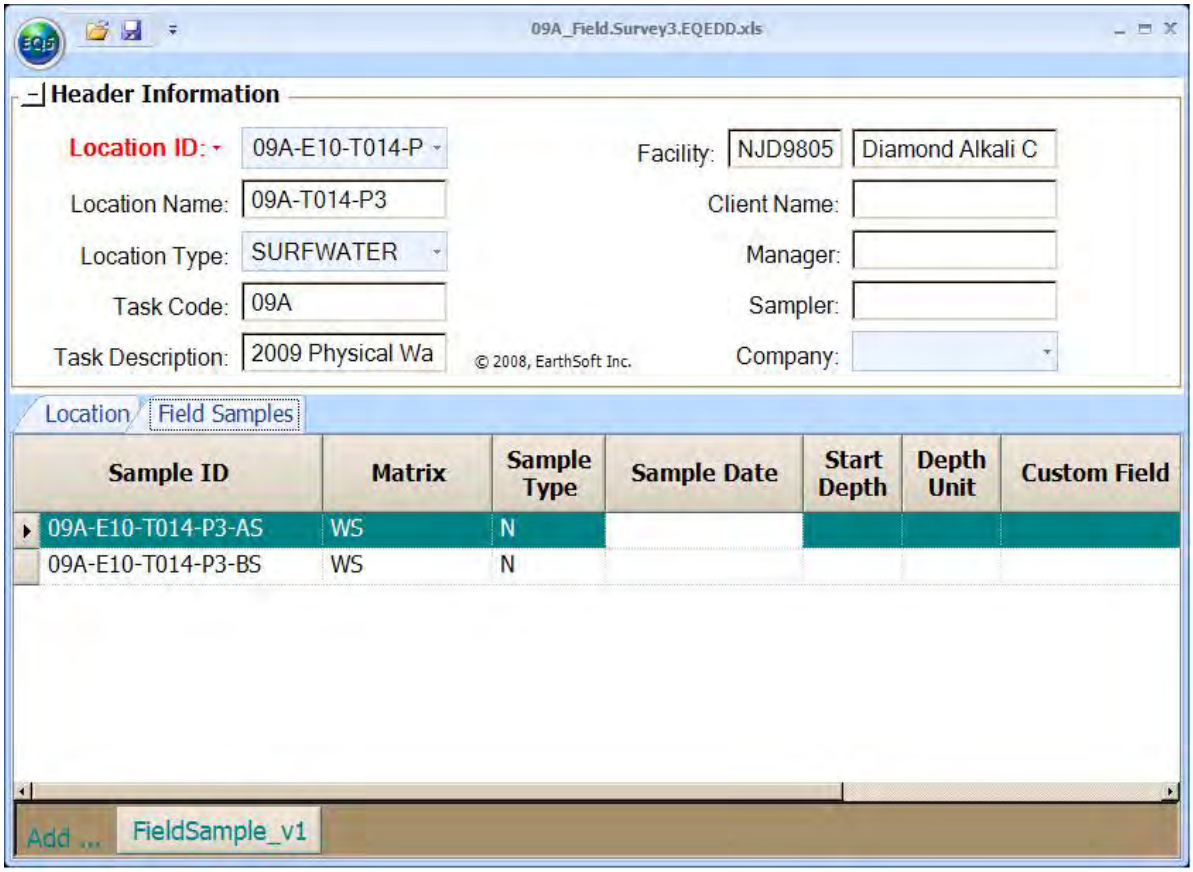
AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011 or current version.MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

USEPA 1996. Method 1669 Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels. July 1996.

10.0 Revision history

Revision	Date	Changes
0	June 2010	NA
1	September 2010	Addition of sample filtering procedure, attachment of IDEF example, minor revisions throughout document
2	July 2011	Addition of collection of dissolved metals samples using water collected into unpreserved bottles prior to filtering; minor revisions throughout document.
3	August 2011	Modification to dissolved metals sample collection.

Attachment 1. Example of IDEF



AECOM

Standard Operating Procedure
Lower Passaic River Restoration Project

Field Records

Procedure Number: LPR-G-01

Revision No.: 7

Revision Date: July 2011

Prepared by

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Dion Lewis

Laura Kelmar, AECOM Project Manager

Date: July 7, 2011

Debra L. Simmons, Project QA Manager

Date: July 7, 2011

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Contents

1.0 Scope and Applicability

1.1 The purpose of this document is to define the standard operating procedure (SOP) for documentation of field activities conducted in the Lower Passaic River Study Area and the Newark Bay Study Area as part of the Lower Passaic River Restoration Project (LPRRP), including sample collection events, field measurements, and site visits. Appropriate documentation of field activities provides an accurate and comprehensive record of the work performed, sufficient for a technical peer to reconstruct the day's activities and determine that necessary requirements were met. Field records also provide evidence and support technical interpretations and judgments. The procedures and systems defined in this SOP help ensure that the records are identifiable (reference the project task/activity), legible, retrievable, and protected from loss or damage.

1.2 LPRRP field data may be recorded electronically or in field logbooks, standardized forms, annotated maps, or photos. This SOP provides general guidance on field recordkeeping; additional details for specific procedures (for example, chain of custody, sample collection) are provided in the SOPs for the individual task.

1.3 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project Quality Assurance (QA) Manager and the Task Manager and communicated to the Cooperating Parties Group (CPG) Project Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from this SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and Safety Considerations

2.1 Although record keeping itself does not generally pose significant health and safety risks, the tasks being implemented in the vicinity of individuals keeping records may require attention to safety practices. Project related physical, chemical and biological hazards are addressed in the site specific Health and Safety Plan (HASP) and associated addendums (MPI, 2005a; MPI 2005b; AECOM 2011).

2.2 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

Not Applicable

4.0 Equipment and Materials

The following equipment list contains materials that may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Bound field logbook
- Standardized field data sheets (refer to Section 5.3)
- Black ballpoint pen, Rite-in-Rain® pen, or black Sharpie® (or equivalent)
- Site maps
- Clipboard
- Three-ring binder or equivalent
- Camera (optional)
- Time piece
- Hand-held electronic recording device (optional) with EQuIS Data Gathering Engine (EDGE)™ software from Earthsoft, Intelligent Data Entry Form® (IDEF) software or equivalent

5.0 Procedures

5.1 General Requirements

5.1.1 The field records will contain sufficient detail so that the collection effort can be reconstructed without reliance on the collector's memory.

5.1.2 Pertinent field information will be recorded legibly in a logbook and/or an appropriate standardized form (as described herein), or directly onto a portable electronic device, such as a laptop computer or Yuma. It is recommended that entries made by hand be made in black ballpoint pen.

5.1.3 Entries will be signed and dated. No erasures or obliterations will be made. A single line will be drawn through incorrect entries and the corrected entry written next to the original strikeout. Strikeouts are to be initialed and dated by the originator.

5.1.4 If a ballpoint pen cannot be used because of adverse weather conditions (rain or freezing temperatures), a fine-point Sharpie® or Rite-in-Rain® pens are acceptable substitutes. If conditions are such that only pencil can be used, an explanation will be included in the logbook and the affected data will be photocopied, signed as verified copy, and maintained in the project files as documentation that the information has not been changed.

5.1.5 Entries will be factual and observational (i.e., no speculation or opinion), and will not contain any personal information or non-project-related entries. Abbreviations and acronyms will be defined.

5.1.6 Field information will be recorded without delay – information recorded significantly after the fact will be dated as such.

5.1.7 Field activities and other events pertinent to the field activities will be documented in chronological order. Times will be recorded using Eastern Standard Time (EST) or Eastern Daylight Savings Time (EDT) notation for each entry.

5.2 Field logbooks

5.2.1 Field logbooks will be bound waterproof field books. LPRRP logbooks will be dedicated to the project and will not be used for any other project or purpose. Separate and dedicated logbooks will be kept for different operations running concurrently (e.g., sample collection on board the vessel, core processing at the CPG field facility, surface water collection on-board a vessel, surface water collection from the shore); individual tasks making up each operation will be maintained in the same logbook, if possible.

5.2.2 The cover and binding of each logbook will be labeled to identify the operation and dates included with the logbook; each page in the logbook will be consecutively numbered. Pages will not be removed or torn out of the logbook.

5.2.3 The title page of each logbook will contain the following:

- AECOM contact, AECOM office location, and phone number;
- The logbook number (assigned at the time the logbook is signed out)
- Project name (LPRRP/Task) and AECOM project number; and
- Start and end dates of work covered by the logbook.

5.2.4 To assist in the return of a field logbook in the event it is lost, the following will also be included on the title page: “$25 Reward if found and returned to AECOM, 250 Apollo Drive, Chelmsford, Massachusetts 01824”.

5.2.5 At the front of each logbook will be a page cross-referencing each author’s printed name, signature, and initials.

5.2.6 A page header will appear on the first page of each day’s notes in the logbook, and activities for each day will be recorded on a new page. The page header will include:

- name of author and other personnel on site (and affiliated organization if applicable);
- date;
- time of arrival (military time);
- proposed activity (task); and
- current weather and tidal conditions, and weather forecast for the day.

5.2.7 An abbreviated header, containing at least the date, will appear at the top of each additional page for the active date. Field forms require similar header information.

5.2.8 The field logbook will provide a chronology of events. At a minimum, documentation in a logbook will include the following (unless documented on a standard form):

- names of visitor(s), including time of arrival and departure, the visitor's affiliation, and reason for visit;
- summary of project-related communications, including names of people involved and time;
- time daily work commences and ceases;
- start and stop times of new tasks;
- start and stop times of significant stand-by time (work interruptions);
- safety or other monitoring data, including units with each measurement;
- deviations from approved scope of work, including the necessary approvals;
- progress updates;
- problems/delays encountered;
- unusual events; and
- signature or initials of author on every page.

Additional detail on the contents of the field logbook is provided in Table 1.

5.2.9 The logbook will cross-reference the field forms if necessary; however, whenever possible, details recorded on the standardized forms will not be replicated in the logbook.

5.2.10 If there are additional lines on the page at the end of the day's activities, a line will be drawn through the empty space, and initialed and dated, leaving no room for additional entries.

5.3 Standardized forms

5.3.1 Standard forms for field data are provided with each SOP. The Daily Activity Log is attached to this SOP (Attachment 1). This form will be completed each day of active work and transmitted to the Task Manager or his/her designee. Refer to the appropriate SOP (e.g., core processing) for the forms specific to that task.

5.3.2 The information collected on any field form may alternately be collected electronically by PC/handheld as appropriate.

5.3.3 The following rules apply to the standardized forms:

- Each form will be signed and dated by the person completing the form.
- There will be no blank spaces on the form – unused spaces will have "not applicable" or "not available" explanations.

5.4 Maps and drawings

5.4.1 Pre-existing maps and drawings that include notations made in the field (for example, relocating of sample locations) will be referenced in the logbook and, like all field records, include the project/task name and number, site identification, and be signed/dated by the person that prepared them.

5.4.2 Maps and drawings will include compass orientation and scale. Sketches will include points of reference and distances to the reference points.

5.5 Photographs and other photo documentation

Photographs or videos may be taken by the field team to help document site conditions, sample locations, or sample characteristics. Photographs and videos will be identified in the logbook or on the standard form by a unique numbering system. If photographs are collected by a digital camera, the file number as well as the photograph number will accompany the description of the photograph in the logbook. At a minimum, the date/time the photograph was taken, the general location, a brief description, and the photographer's name will be recorded. Additional information may include Differential Global Positioning System (DGPS) coordinates, direction the photographer was facing, and/or weather conditions. If necessary, an object will be included to indicate the scale of the object in the photograph.

5.6 Electronic files

5.6.1 Electronically recording devices may include data logging systems, PDAs, laptops, or tablet PCs.

5.6.2 Sufficient backup systems will be in place to protect against electronic data loss. Information will be saved to a disk or backed up immediately upon completion. The backup disk or other media (CD, flash drive) will then be stored in a secure location separate from the laptop, tablet, or PDA.

5.6.3 Files will be uniquely identified and will be stored in the project files on the network in accordance with the Lower Passaic River Project Quality Management Plan (AECOM 2009). Files will be labeled per Worksheet #27 of the QAPP. An unedited version of the file will be maintained and all subsequent manipulations tracked.

6.0 Quality Assurance/Quality Control

6.1 Entries in the field forms will be double-checked by the field team members to verify the information is correct.

6.2 Completed field forms will be reviewed by the Field Task Manager and/or his/her designee to verify that the requirements are being met. At a minimum, this should occur at the end of each day. When the review is complete, the reviewer will append his/her initials and date to the pages reviewed for documentation purposes.

6.3 If information recorded in the field is transcribed to another format, the original record will be retained for comparison purposes.

7.0 Data and Records Management

7.1 Deviations to the procedures detailed in the SOP or approved plans will be noted in the field logbook or other appropriate field form at the time of occurrence and summarized on the Daily Activity Log (Attachment 1). A formal nonconformance report (NCR) will be completed (Attachment 2) and distributed as specified in the QAPP.

7.2 Proposed modifications to the SOPs or approved plans will be documented on a Field Modification form and submitted to USEPA. An example Field Modification form is presented as Attachment 3.

7.3 Logbooks, field forms, chain of custody forms, and all other records associated with the activities described in this SOP will be ultimately maintained in accordance with the Lower Passaic River Project Quality Management Plan (AECOM 2009).

7.4 Logbooks that are taken offsite from the field facility will be photocopied or scanned and filed at the end of each day to mitigate against the loss of historical entries should the logbook be lost in the field.

7.5 Field data forms and chain of custody will be filed in the field facility once they have been completed and distributed (if necessary), or at the end of each field day. These documents will be maintained in labeled three-ring binders or contained in some other organized manner that prevents loss.

7.6 Distribution of daily forms will be performed according to the needs of the project team and at the direction of the Field Task Manager or designee. Refer to the Lower Passaic River Data Management Plan (AECOM, 2010) for the frequency and distribution of field data and chain-of-custody transmittal information.

8.0 Personnel Qualifications and Training

8.1 Individuals executing these procedures will have read and be familiar with the requirements of this SOP and the corresponding LPRRP plans (e.g., HASP, QAPP, DMP, FSP). No specialized training is required. Nonetheless, these activities should be reviewed by the Field Task Manager, as described below.

8.2 The Field Task Manager is responsible for reviewing and approving the field records for accuracy, completeness, and conformance to the procedures in this SOP. The Field Task Manager is also responsible for ensuring that the field records are distributed to the appropriate personnel during field activities, ensuring that records are maintained properly on site, and for archiving the records upon completion of field activities.

9.0 References

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-2007-2009. September 2009 or current version.

AECOM 2010. Lower Passaic River Data Management Plan. July 2010 or current version.

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011 or current version.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

Tierra 2007. Standard Operating Procedure No. 8 (Revision 2), Field Documentation. Newark Bay Study Area Phase II RIWP, Appendix F, October, 2007.

10.0 Revision History

Revision Date		Changes
0 May	2008	NA
1	July 2008	Added cross-reference as Section 5.2.5; updated Table 1; added unique file ID scheme to Section 5.6.3
2	September 2009	Included Field Modification and Nonconformance forms; "ENSR" to "AECOM"; minor editorial changes
3	February 2010	Modify to include IDEF option; Table 1 footnote update; addition of Attachment 2-3 names on Contents page
4	June 2010	Updated text to reflect general sampling procedures where sediment specific wording was used.
5	September 2010	Minor revisions throughout document
6	June 2011	Minor revisions throughout document
7	July 2011	Minor revisions throughout document

Table 1 LPR Summary of Field Information

General Information	Applicable Record[1]
Project/task name/general location	All
Personnel on site (AECOM, clients, site contacts, regulators, oversight personnel, subcontractors, general public)	A, B, K
Results of phone calls, conversations (See QAPP Worksheet #3 for project contact information)	B
Chronology of activities, including mobilization, investigatory activities, and demobilization	B
Weather conditions (initial and any changes; temperature, barometric pressure, wind conditions, precipitation)	B, D
Tidal and atmospheric information (if applicable)	B, G
Subcontractors, description of services to be provided, and any issues (equipment problems, corrective action, stand by time)	A, B
Health and safety (H&S) tailgate meetings, H&S monitoring	Refer to HASP
Description of major equipment (survey vessels, sampling platforms, sampling devices) and any problems or conditions that might impact performance or data quality	A, B, J
Equipment decontamination	B, D, E
Any pertinent field observations such as difficulties in sampling or conducting measurements or unusual circumstances that could affect data quality (instrument problems, contamination sources)	B, D, J
Deviations from approved plan (schedule, relocation/elimination of locations, change orders), including rationale and approval	A, B, J
Sample collection and transfer summary, custody information from collection through analysis, to final disposal	C, D, E, H
Investigation-derived waste (IDW) types, volumes, storage, and disposal	F
Field measurements	
Description of Instruments (make, model, serial number) and inspection	B, G
Instrument calibration (date, time, personnel, standard, standards used/expiration date, and results)	B, G
Measurement date, time, location/station, results (units, any correction factors applied, calculations (if applicable)	D, E, G, L
Identity of person performing the measurements	D, E, G, L
Sampling information	
Equipment description and inspection	B, D
Sample selection criteria/rationale (if different from plan)	A, B, D, J
Sample location (GPS coordinates, depth, compass/distance from fixed points)	D
Sample description (recovery, moisture, color, odor, texture, general sediment profile/stratigraphy, PID screening results, artifacts)	D, I
Sample manipulations (homogenization, compositing, filtering, preservation)	D, E
Sample ID, segment/interval, date, time, and sampler identity	D, E, H
Sample parameters, containers (size/type), preservation	
Field and QC sample ID, storage container and conditions for each (sub)sample/parameter set	D, C, E

[1] Locations for this information may include but are not limited to: A: Daily Activity Log; B: Field Notebook; C: COC Form; D: Sample Collection Form; E: Sample Processing Form; F: IDW Logs; G: Water Quality Data Log; H: Sample Transfer and Custody Form; I: Core Logging Form; J: Nonconformance Form; K: Site Log-in Record; L: In-Situ Data Log

Attachment 1 Example of Daily Activity Log

AECOM

Daily Activity Log
Lower Passaic River Restoration Project
Project No.: 60145884
Task: _____
Date: _____

Vessel/Sampling Platform:
Personnel (Name/Affiliation/Role)
Sampling Performed/Equipment Used:
Stations Sampled:
Health and Safety Issues:
Deviations from Approved Plan:
Dock Departure Time:
Dock Return Time:
Recorded by:

Revision 2, June 2011

Attachment 2 Example of Field Modification Form

Field Modification Form
Lower Passaic River Restoration Project
Remedial Investigation
Project No: 60145884

AECOM

Field Modification Number:	
Document (plan or SOP title and date)	
Activity:	
Proposed Modification:	
Effective Date:	
Rationale:	
Submitted by	**Date:**
FTM Approval:	**Date:**
Project QA Manager Approval:	**Date:**
Task Manager Approval:	**Date**

Revision 2, June 2011

Attachment 3 Example of Nonconformance Form

AECOM

Nonconformance Report
Lower Passaic River Restoration Project
Remedial Investigation
Project No: 60145884

Nonconformance Number:	
Document (plan or SOP title and date)	
Activity:	
Nonconformance:	
Date of Nonconformance:	
Ramifications/Corrective Action:	
Submitted by	**Date:**
Project QA Manager Review:	**Date:**
Task Manager Review:	**Date:**
Other Approval:	**Date**

Revision 2, June 2011

AECOM

Standard Operating Procedure
Lower Passaic River Restoration Project

Navigation/Positioning

Procedure Number: LPR-G-02

Revision No.: 5

Revision Date: July 2011

Prepared by

Kristen Durocher

Laura Kelmar, Project Manager

Date: July 7, 2011

Debra L. Simmons, Project QA Manager

Date: July 7, 2011

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Contents

1.0 Scope and Applicability

1.1 The purpose of this document is to define the standard operating procedure (SOP) for positioning vessels in the Lower Passaic River Study Area and the Newark Bay Study Area as part of the Lower Passaic River Restoration Project (LPRRP). Positioning will be conducted to locate the vessel(s) with sufficient accuracy and precision to meet project objectives during sampling or measurement activities.

1.2 This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to position vessels. Specific information regarding proposed sampling and/or measurement locations is provided in the LPRRP Quality Assurance Project Plan (QAPP).

1.3 It is fully expected that the procedures outlined in this SOP will be followed by the field team. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project Quality Assurance (QA) Manager and the Task Manager and communicated to the Cooperating Parties Group (CPG) Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from the SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and Safety Considerations

2.1 The health and safety (H&S) considerations for the work associated with this SOP, including physical, chemical, and biological hazards are addressed in the site specific Health and Safety Plan (HASP) and associated addendums (MPI, 2005a; MPI 2005b; AECOM 2011). The major health and safety considerations for the work associated with navigating/positioning the vessel are the marine safety aspects of the program

2.2 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

Differential global positioning system (DGPS) signal interferences/blockage can occur from time to time by bridges or other structures. These interferences can prevent system function until satellite signals are re-established. If insufficient satellite coverage occurs for proper function, the user will be alerted by the HYPACK system. In these cases the vessel will be repositioned to obtain better satellite coverage.

4.0 Equipment and Materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by the HASP;
- sampling vessel(s) adequately sized and equipped for the task and expected conditions on the Passaic River, including high frequency (VHF) radio, ground tackle, and required U.S. Coast Guard safety gear;
- navigation charts and sampling/measurement locations figure;
- electronic navigation charts with pre-loaded waypoints for all sampling and measurement locations - refer to the corresponding LPRRP QAPP;
- DGPS Receivers (x2) with an accuracy of $\pm$1 foot;
- DGPS External Antennas (x2);
- field laptop computer with HYPACK survey software;
- fixed water level measurement and recording gauges (approximately one per river mile);
- equipment user manuals;
- table of target sampling/measurement location coordinates;
- assorted nautical equipment (e.g., anchors, lines, personal flotation devices);
- logbook and ballpoint pen;
- sample collection forms; and
- RTK DGPS positioning system (optional).

5.0 Procedures

Sampling and measurement activities will be conducted from a vessel. In accordance with procedures outlined below, these vessels must be properly positioned and their position recorded before each activity can begin. The following describes the procedures that will be performed to accurately position sampling vessels at a designated sampling location, and the pertinent observations that will be recorded in the appropriate field notebook and/or data sheet.

Positioning will be achieved by using a DGPS integrated with HYPACK survey software in order to obtain the real time position of the vessel, in relation to planned sampling stations, displayed on an electronic nautical chart. Survey personnel will follow the appropriate sections of equipment user's manuals to ensure proper equipment operation and system performance.

5.1 Positioning the vessel

This section gives the step-by-step procedures for vessel positioning. Observations made during vessel positioning will be recorded on the sample collection forms, other standardized forms, and/or logbook, as appropriate.

A DGPS will be used to establish locations during implementation of activities specified in the LPRRP QAPP. Two DGPS units will be required: one on board the vessel with a receiving antenna to be aligned with the deployment of the sampling apparatus, and the other at a known fixed location (monument or temporary benchmark) to provide corrections to the standard GPS signal.

While this SOP provides general guidance and procedural steps, personnel performing positioning activities also will follow the appropriate sections of equipment user's manuals and have the manuals available for reference while operating the equipment.

The following procedures describe the steps to establish position at a location, as well as the steps to adjust the positioning for collection of additional samples.

5.1.1 Obtain the appropriate form(s). Initiate the Daily Activity Log provided in SOP LPR-G-01 (Field Records).

5.1.2 Obtain the target sampling/measurement locations. These locations will have been selected prior to commencement of field activities, as described in the QAPP. The location of each target sampling location will be established in the New Jersey State Plane Coordinate System with respect to the North American Datum of 1983 (NAD83).

5.1.3 Enter the coordinates for each sampling location as a waypoint into the HYPACK software package. Confirm accuracy of each entry against the coordinates established in the corresponding LPRRP QAPP.

5.1.4 Configure the HYPACK system for the survey, including setting the survey grid to the New Jersey State Plane Coordinate System with respect to the North American Datum of 1983 (NAD83 - feet), and setting the "target ring" or maximum allowable offset based on task specific requirements listed in the corresponding LPRRP QAPP.

5.1.5 If less than sub-meter accuracy is required, a DGPS base station will be established over a shore-based marker prior to sampling or measurement operations. The operation and horizontal/vertical accuracy of the vessel mounted DGPS will be verified at another shore-based marker by recording observed horizontal and vertical (XYZ) data and comparing these data to the published XYZ data for a given point. After initial DGPS system verification, a temporary benchmark may be established at a location convenient to the vessel to facilitate daily DGPS system performance verification. DGPS system performance verification will be conducted twice per day and documented in the logbook and vessel data logger. The horizontal and vertical accuracy will be compared to shore-based markers to verify performance. Elevations will be recorded in North American Vertical Datum of 1988 (NAVD88) with an accuracy of +/- one foot.

5.1.6 Install the DGPS antennae in a safe location which accurately represents the actual sample or measurement collection point; (e.g., immediately adjacent to a coring well, or mounted to the A-frame).

5.1.7 Identify and approach actual sampling/measurement locations by using data from the DGPS/HYPACK system in the navigation mode. The navigation mode provides information on heading, distance remaining, and time remaining. This information is based on the selected waypoint location and the present location of the vessel.

5.1.8 For sediment sampling, the vessel will be secured by lowering spud poles once in position within the station "target radius". In water depths that preclude the use of spud poles, maneuver the vessel approximately 60 feet up-current (or up-wind in slack conditions) of the target, drop the anchor, and pay out anchor line until the vessel drifts within the "target radius". A second anchor set may be required to increase lateral stability under certain conditions.

5.1.9 For water column sampling, the vessel will be positioned over each sampling/measurement location with no contact with the bottom. The operator will utilize the onboard navigation system to maintain positioning of the vessel within 10 feet of the sampling/measurement location. The water sampling apparatus will be secured to a CTD-OBS vertical profile unit or YSI datasonde which will be viewed on the vessel in real time. As the field crew conducts the vertical profile, the unit will be stopped at various depths to collect the water samples while making no contact with the riverbed.

5.1.10 Once the vessel is on location (and secured, for sediment sampling), note the coordinates from the DGPS unit and check the coordinates to verify that the vessel is within the pre-determined range of the target location as defined in QAPP. If not acceptable, adjust the vessel's location, and recheck the position. Repeat this process until the vessel's position is within acceptable range of the target. Record the final coordinates on the appropriate form. Record the actual sampling coordinates electronically (using HYPACK).

5.1.11 Once the coordinates are acceptable, perform the sampling or measurement activity at the location. Record final location coordinates on the appropriate form. For sediment sampling, final location coordinates will be recorded once the sampling device has penetrated the sediment to the target depth or refusal and prior to retrieval. Plot locations onto a master chart or use computer-based, real-time software to verify location.

5.1.12 To adjust the vessel's position to repeat an attempt at sediment sampling, the vessel will be moved by allowing it to rotate around the spud pole or by adjusting an anchor line until the new position for the sampling device has been established. Record the new position.

5.1.13 At the end of the sampling day, check the data loaded onto the DGPS units to verify the existence of locations where data were collected. Download HYPACK navigation files to a portable data storage device and transfer data to an applicable secure project directory (AECOM 2010).

5.2 Elevation measurements

5.2.1 In order to establish the elevation of the sediment surface at locations within the river, a system will be established whereby the water level of the river is continuously monitored and recorded for use as a local reference. This system will consist of a number of transducer/data loggers (tide gauges) for measuring and recording the water level at

approximately one-mile intervals (or more closely spaced, as necessary) along the Lower Passaic River. The benchmark elevation of each water level recorder will be surveyed to the North American Vertical Datum of 1988 (NAVD88) with an accuracy of 0.01 foot. Once the benchmark elevation for a station is established it can be re-located as necessary for coverage of the active work area. The water level at each tide station will be recorded approximately every 15 minutes, and the data downloaded weekly.

5.2.2 At each sampling point on the river where elevation data is required, the depth from the water level to the sediment surface will be determined as specified in the SOP for the activity being performed. The time of the measurement will be recorded. The water surface elevation at the time of the measurement will be determined by comparison to the closest water level recorders, with interpolation between measuring points as necessary.

5.3 Calibration, maintenance, and use of field instruments

5.3.1 Poor DGPS Reception or System Failure

If insufficient satellite coverage occurs for proper function, the user will be alerted by the HYPACK® system. In these cases the Field Task Manager will be notified that verification of the field position of the vessel at the target location cannot be performed. The Field Task Manager will review the situation with respect to available reference resources and may provide the field team with alternate locations, as required by the QAPP. The selection of alternate sampling locations will be made jointly through discussions with the Field Task Manager and the boat personnel.

When satellite reception is insufficient to meet system accuracy requirements, system error codes will appear on the output screen. Nonetheless, proper operation of the DGPS / HYPACK navigation system can be verified by checking the displayed vessel position on the electronic base map against surrounding geographic features. This activity will be undertaken at the start of each day after start-up as a quick check to verify proper system function. Note: system function errors will be obvious and rigorous checking of the system is not necessary.

5.3.2 Maintenance

Prior to use, the DGPS units will be inspected for functionality. Maintenance and use of DGPS units will follow the appropriate sections of the equipment user's manual. Field personnel will have the manual available for reference. Equipment maintenance will be recorded in the field logbook, including the reason for the maintenance (routine or because of a problem), actions taken, and final resolution (e.g., correction of the problem, replacement of the instrument).

6.0 Quality Assurance/Quality Control

6.1 Actual sampling/measurement locations will be verified as being within the QAPP-specified radius/tolerance surrounding the target coordinates specified in the corresponding LPRRP QAPP. Using a HYPACK navigation system allows the user to see the real time position of the sampling vessel in relation to the designated position of the sampling/measurement station and the user defined “target radius” surrounding each station. This visual confirmation on the electronic chart is

also complimented by a HYPACK data display that indicates the actual distance to target. Using these two features ensures proper vessel positioning.

6.2 DGPS system performance will be verified by confirming the accuracy of the initial HYPACK configuration (i.e., geographic reference) and by regular system checks during the course of the day.

6.3 The quality of the data provided by the DGPS unit is monitored by HYPACK as another control feature built into the system. In the event there is degradation in DGPS signal quality, either by a reduced number of available satellites or satellite geometry, the HYPACK system will alert the operator of the reduced quality of horizontal and vertical precision levels.

6.4 Data recorded manually and electronically (see Section 7.2) will be cross-checked for accuracy

7.0 Data and Records Management

7.1 Field records will be generated as outlined in SOP LPR-G-01 (Field Records). This document provides specifics on recording data for field activities. At a minimum, sample position information (x, y, and z), verification of DGPS system performance, and any positioning-related problems encountered will be recorded. Additional information may be required for sample collection or measurement activities and are outlined in the relevant SOPs.

7.2 Position data will be saved electronically at the time of sampling within HYPACK and recorded manually on the sample collection/measurement forms. Although the electronic record represents the primary record, the sample collection/measurement form information will serve as a backup to the electronic file.

7.3 Position data (actual sample locations) will be downloaded and transmitted to the AECOM Data Management Task Manager at the frequency stated in the Data Management Plan (AECOM, 2010).

7.4 Deviations to the procedures detailed in the SOP will be recorded in the field logbook at the time of occurrence and summarized on the Daily Activity Log (refer to SOP LRP-G-01 – Field Records). A formal nonconformance report (NCR) will be completed (refer to SOP LRP-G-01 – Field Records) and distributed as specified in the QAPP.

7.5 All records (electronic and hard copy) associated with the activities described in this SOP will be maintained in accordance with the LPRRP Quality Management Plan (AECOM, 2009).

8.0 Personnel Qualifications and Training

Individuals executing these procedures will have read, and be familiar with, the requirements of this SOP. Vessel navigation and positioning will only be performed by experienced DGPS / HYPACK operators.

9.0 References

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-2007-2009. September 2009 or current version.

AECOM 2010. Lower Passaic River Data Management Plan. July 2010 or current version.

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011 or current version.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

Tierra 2007. Standard Operating Procedure No. 2 (Revision 2), Positioning. Newark Bay Study Area Phase II RIWP, Appendix F, October, 2007.

10.0 Revision History

Revision Date		Changes
0 May	2008	NA
1	July 2008	Minor revisions to all sections; added elevation measurements as Section 5.2
2	September 2009	Minor revisions to expand procedures to include water column sampling and measurements
3	September 2010	Minor revisions throughout document
4	June 2011	Minor revisions throughout document
5	July 2011	Included Newark Bay Study Area; other minor revisions

Standard Operating Procedure
Lower Passaic River Restoration Project

Equipment Decontamination

Procedure Number: LPR-G-03

Revision No.: 5

Revision Date: July 2011

Prepared by

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Laura Kelmar, AECOM Project Manager — Date: July 7, 2011

Debra L. Simmons, Project QA Manager — Date: July 7, 2011

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Contents

1.0 Scope and Applicability

The purpose of this document is to define the standard operating procedure (SOP) for decontamination of equipment, instruments, and other materials used during implementation of field tasks in the Lower Passaic River Study Area and the Newark Bay Study Area as part of the Lower Passaic River Restoration Project (LPRRP). Decontamination is the process of neutralizing, washing, and rinsing exposed surfaces of equipment to minimize the potential for contaminant migration and/or cross-contamination. This procedure does not apply to personnel decontamination which is described in the site-specific Health and Safety Plan (HASP) and associated addendums (MPI 2005a; MPI 2005b; AECOM 2011).

It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications to this SOP may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project Quality Assurance (QA) Manager and Task Manager and communicated to the Cooperating Parties Group (CPG) Project Coordinator and to the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from this SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and Safety Considerations

2.1 The health and safety considerations for the work associated with this SOP, including physical, chemical and biological hazards, are addressed in the HASP and associated addendums (MPI 2005a; MPI 2005b; AECOM 2011).

2.2 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

3.1 Equipment decontamination should be performed in an area that does not interfere with sampling activities, but sufficiently close to maintain an efficient working environment. Whenever possible, decontamination activities will be performed in a location that is not subject to potential sources of contamination (for example, generators and other combustion engines). Where decontamination is required on a boat, the vessel's engines must be turned off during decontamination. Ideally, boat engines and/or generators should be shut off during collection of equipment blanks, consistent with collection of river water samples. If this is not possible, then the sampling platform should be positioned upwind from any running combustion engines.

3.2 Equipment that is improperly or inadequately decontaminated may result in biased sample results. To avoid sample contamination, the procedures and equipment specified in this SOP are to be followed. Specifically:

- The decontamination materials, including detergent, water, solvents, and acids, will meet the specifications of the SOP;
- Buckets and other containers holding decontamination solutions will be labeled to segregate containers holding "dirty" from "clean" solutions, and brushes will be dedicated to a particular step in the decontamination process; and
- Decontaminated equipment that is not immediately reused will be covered/wrapped in plastic or aluminum foil (shiny side out) and marked to indicate it is clean.

4.0 Equipment and Materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by the HASP;
- bristle brushes;
- plastic wash/rinse buckets or tubs;
- phosphate-free biodegradable detergent (e.g. Liquinox®, Alconox®);
- Joy® (or equivalent) detergent (for oily residues);
- 10% nitric acid, reagent grade;
- methanol (pesticide grade or better in separate Teflon bottles);
- hexane (pesticide grade or better in separate Teflon bottles);
- deionized "analyte-free" water (DIW);
- stainless steel bowls or pans (labeled as needed);
- squeeze bottles (Teflon® for solvent)
- aluminum foil;
- plastic sheeting;
- zipper-lock bags;
- tap water (from any treated municipal water supply);
- high-pressure/steam cleaner;
- sample container(s) for equipment rinsate blank, if collected;
- investigation-derived waste (IDW) storage containers (refer to SOP LPR-G-04); and
- field logbook and standardized forms as needed.

5.0 Procedures

Sampling equipment (including newly purchased equipment) that comes into contact with the media to be sampled will be decontaminated prior to use in the field to eliminate or minimize cross-contamination. The frequency of decontamination is provided in the task-specific SOPs (for example, surface water sampling, grab sampling, sediment collection via vibracore, core processing). Sufficient decontaminated equipment will be available to be dedicated to the sampling locations planned for each day, where feasible. Equipment will be decontaminated in the area designated for decontamination.

For the LPRRP, surface water and sediment samples may be submitted for chemical, radiochemical, biological, and geotechnical analyses as described in the Quality Assurance Project Plan (QAPP). Sampling equipment will be decontaminated as described in Section 5.0 below. Decontamination of the sampling equipment will be commensurate with the analyses to be performed.

Solvents used during decontamination activities will be collected and handled in accordance with residuals management procedures outlined in SOP LPR-G-04 – Investigative Derived Waste (IDW) Handling and Disposal.

Not all sampling equipment will require full decontamination procedures. Three levels of decontamination (i.e., solvent, soap and water, or ambient water decontamination) will be performed based on the usage of the sampling equipment as defined below.

5.1 General preparation

Inspect equipment needed for sample collection to ensure that it is in good working order and establish an equipment decontamination area that includes a collection basin that can be placed beneath the equipment to collect decontamination fluids, brushes, and a series of wash bottles for each of the solutions specified in the following section. An IDW container and storage system will also be established as outlined SOP LPR-G-04 – Investigative Derived Waste (IDW) Handling and Disposal.

5.2 Level I (Decontamination with Ambient Water): The following steps will be used to decontaminate sampling and support vessels, vessel anchors, lines, ropes, vibracoring head, and buoy marker weights:

5.2.1 Personnel will dress in suitable PPE to reduce exposure to contaminants (refer to the HASP).

5.2.2 Equipment will be rinsed with river water onboard the sampling vessel.

5.2.3 Rinse water will not be contained.

5.2.4 Daily decontamination of the decks of the vessels will consist of a river water washing as soon as possible after concluding work. Further wash-down with tap water at the marina is at the discretion of the boat's captain.

5.3 Level II (Decontamination with Soap and Water): The following steps will be used to decontaminate equipment that is not intended to collect samples for chemical analysis (e.g., sample storage coolers):

5.3.1 Personnel will dress in suitable PPE to reduce exposure to contaminants (refer to the HASP).

5.3.2 Residual sediment will be scraped off and the equipment rinsed with site/river water (on the sampling vessel while on site).

5.3.3 Residual sediment on equipment that is decontaminated at the field facility will be collected according to IDW procedures outlined in SOP LPR-G-04 – IDW Handling and Disposal.

5.3.4 Equipment may be rinsed with tap water if needed to further remove gross contamination.

5.3.5 Equipment will be placed in a wash tub or bucket (if size allows) containing Alconox® (or other phosphate-free detergent) along with tap water, and scrubbed with a bristle brush or similar utensil.

5.3.6 Equipment will be rinsed twice with tap water over a bucket using a squeeze bottle or pressure washer.

5.3.7 Following decontamination, equipment will be placed in a dedicated clean area or will be protected from re-contamination by covering with plastic or wrapping in foil.

5.3.8 Rinse water and detergent water will be replaced frequently. Residual decontamination water used on the boat will be held in 5-gallon buckets, labeled, and transferred to the field facility for collection and ultimate disposal in accordance with IDW procedures outlined in SOP LPR-G-04 – Investigation Derived Waste (IDW) Handling and Disposal.

5.4 Level III (Decontamination with Solvents): The following decontamination procedure is based on a modification of the Region 2 procedure (USEPA, 1989). The following steps will be used to decontaminate small sampling equipment that will come into contact with sediment or surface water designated for chemical analysis. This sampling equipment includes stainless steel trowels, spoons and bowls, core tubes, stainless steel core cutters and catchers, plastic caps for the core tubes, trigger-activated bottle samples, and CFLEX tubing. Sampling devices will be decontaminated between collection of samples at different depths and different times at the same sampling location.

5.4.1 Personnel will dress in suitable PPE to reduce exposure to chemicals and contaminants (refer to the HASP).

5.4.2 Any residual sediment will be scraped off and the equipment rinsed with site/river water (on the vessel while on site).

5.4.3 Residual sediment on equipment that is decontaminated at the field facility will be collected according to IDW procedures outlined in SOP LPR-G-04 – Investigative Derived Waste (IDW) Handling and Disposal.

5.4.4 Equipment may be brushed and rinsed with tap water if needed to further remove gross contamination.

5.4.5 Equipment will be placed in a wash tub or bucket containing Alconox (or other phosphate-free detergent) along with tap water, and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water over a second wash tub or bucket, using a squeeze bottle or pressure sprayer, followed by a 10% nitric acid rinse (for metals analyses), a DIW rinse, a methanol rinse, a hexane rinse (for organic analyses), and lastly with a DIW rinse. Rinses shall utilize sufficient amounts of solvent/water to flush rather than just wet the surface. The volume of DIW used during the rinse must be at least five times the volume of solvent used.

5.4.6 Core liners will be decontaminated by pouring a small amount of detergent and tap water into each core, capping the ends, and agitating the core liner so that all surface areas are flushed with the liquid. The detergent and tap water will be containerized as IDW and the process repeated with tap water, 10% nitric acid, DIW, methanol, hexane, and DIW. All

decontamination solutions will be containerized as IDW and handled as described in Section 5.4.8.

5.4.7 Following decontamination, equipment will be placed in a clean area on clean aluminum foil or plastic sheeting and allowed to air dry. Following air drying, the equipment will be wrapped in aluminum foil, shiny side out, or placed in a zipper-lock bag, if not immediately re-used for sample collection. Larger equipment may be wrapped in clean plastic sheeting. Equipment that may be used immediately (i.e., before fully air dried) may be reused providing obvious deionized water has been shaken off. Core liners will be capped with clean caps, and the caps taped in place. The core liners will then be placed back into their original packaging for storage. Clean equipment should be marked in some way to indicate that it is clean. Core liners will not be marked; instead, caps taped in place on both ends of a liner will indicate that it has been decontaminated.

5.4.8 Used decontamination solutions and associated materials will be collected for ultimate disposal in accordance with IDW procedures outlined in SOP LPR-G-04 – Investigative Derived Waste (IDW) Handling and Disposal. Equipment decontamination waste materials generated on the vessel will be collected in 5-gallon buckets, labeled, and transferred to the field facility for disposal.

5.5 Field instrumentation should be cleaned according to the manufacturer's instructions. Care will be taken to prevent damage to equipment. Field instruments such as water quality meters will be rinsed daily during field operations at the end of each workday with DIW at a minimum, or more rigorously according to the manufacturer's instructions. When possible, instruments which are difficult to decontaminate, such as cameras and data logging instruments, may be protectively wrapped to reduce or eliminate the need for decontamination.

5.6 Pumps used for surface water sampling will be rinsed with tap water prior to and following each day of use. Decontamination of the pump between stations or between depths is not required. Tubing will be received from the laboratory pre-cleaned and in dedicated packaging and will not require decontamination in the field.

5.7 Other sampling equipment that might be used and that has had direct contact with sediments or wastes will be decontaminated at a designated area prior to leaving the Site. If the above decontamination procedures are not applicable or feasible, the decontamination procedure will be as follows:

5.7.1 Equipment will be wrapped or draped in plastic or placed in the plastic-lined cargo area of a truck for transport to the area designated for decontamination.

5.7.2 Equipment will first be washed with a hot water, high-pressure spray or steam-cleaned.

5.7.3 Equipment will then be rinsed, by hose or high pressure spray, with tap water.

5.7.4 Wash and rinse water will be collected and handled in accordance with IDW procedures outlined in SOP LPR-G-04 – Investigative Derived Waste (IDW) Handling and Disposal.

5.8 Equipment leaving the Site upon the completion of on-site investigation activities will be decontaminated according to Sections 5.2, 5.3, 5.4, 5.5, or 5.6, above.

5.9 Equipment rinsate blanks will be collected to assess the adequacy of equipment decontamination procedures. Equipment rinsate blanks will be submitted for testing at the frequency specified in the

QAPP. The equipment rinsate blank collection procedures are included in the SOPs for the individual tasks (surface water sampling, sediment sampling, core processing, etc.).

6.0 Quality Assurance/Quality Control

6.1 Decontamination QA/QC procedures described in Section 5.0 will be performed to assess the adequacy of equipment decontamination procedures. Equipment rinsate blanks will be collected at the frequency specified in the QAPP (QAPP Worksheet #20).

6.2 It is the responsibility of the Field Task Manager to periodically check/ensure that the equipment decontamination procedures are in conformance with those stated in this SOP.

7.0 Data and Records Management

7.1 Documentation of decontamination procedures will be contained in the field logbook or recorded on the appropriate task-specific standardized form and should include:

- a list of equipment being decontaminated along with the date and time;
- a brief description of the procedure and materials used during the process (e.g., Level I/ambient water rinse; Level II/soap and water rinse; Level III/acid and solvent rinse);
- the names of the project staff performing the decontamination;
- documentation of equipment rinsate blanks including sample ID, date and time, the equipment rinsed, collector, and parameters; and
- IDW storage and disposal.

7.2 Field data will be distributed to the appropriate personnel as described in the Lower Passaic River Data Management Plan (DMP; AECOM 2010).

7.3 Deviations to the procedures detailed in the SOP will be recorded in the field logbook at the time of occurrence and summarized on the Daily Activity Log (refer to SOP LRP-G-01 – Field Records). A formal nonconformance report (NCR) will be completed (refer to SOP LRP-G-01 – Field Records) and distributed as specified in the QAPP.

7.4 All records associated with the activities described in this SOP will be ultimately maintained in accordance with the Lower Passaic River Restoration Project Quality Management Plan (AECOM 2009).

8.0 Personnel Qualifications and Training

Individuals executing these procedures will have read, and be familiar with, the requirements of this SOP and the corresponding LPRRP plans (e.g., HASP, QAPP, DMP). Decontamination of field

equipment is a relatively simple procedure; no specialized training is needed. However, execution of these activities will initially be supervised by more experienced personnel.

9.0 References

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-2007-2009. September 2009 or current version.

AECOM 2010. Lower Passaic River Data Management Plan. July 2010 or current version.

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011 or current version.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

Tierra 2007. Standard Operating Procedure No. 2 (Revision 2), Decontamination. Newark Bay Study Area Phase II RIWP, Appendix F, October, 2007.

USEPA 1989. Region II CERCL Quality Assurance Manual. Revision 1. October 1989.

10.0 Revision History

Revision Date		Changes
0 April	2008	NA
1	July 2008	Added Section 5.4.6 to discuss decontamination of core lines; reworded Section 5.3.8; corrected minor typos
2	June 2010	Added information specific to surface water sampling; logo change.
3	September 2010	Minor changes throughout the document
4	June 2011	Minor changes throughout the document
5	July 2011	Minor changes throughout the document

Standard Operating Procedure
Lower Passaic River Restoration Project

Investigative Derived Waste (IDW) Handling and Disposal

Procedure Number: LPR-G-04

Revision No.: 5

Revision Date: July 2011

Prepared by

Kristen Durocher

Laura Kelmar, Project Manager — Date: July 7, 2011

Debra L. Simmons, Project QA Manager — Date: July 7, 2011

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Standard Operating Procedure
Lower Passaic River Restoration Project
Investigative Derived Waste (IDW) Handling and Disposal

Contents

Standard Operating Procedure
Lower Passaic River Restoration Project
Investigative Derived Waste (IDW) Handling and Disposal

1.0 Scope and Applicability

1.1 The purpose of this document is to define the standard operating procedure (SOP) for disposal of sediment, water, personal protective equipment (PPE), and other potentially contaminated materials generated during operations conducted in the Lower Passaic River Study Area and the Newark Bay Study Area as part of the Lower Passaic River Restoration Project (LPRRP).

1.2 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications to this SOP may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modifications to this SOP will be approved in advance by the Project Quality Assurance (QA) Manager and the Task Manager and communicated to the Cooperating Parties Group (CPG) Project Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from this SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and Safety Considerations

2.1 The health and safety considerations for the work associated with this SOP, including physical, chemical, and biological hazards, are addressed in the site specific Health and Safety Plan (HASP) and associated addendums (MPI 2005a; MPI 2005b; AECOM 2011).

2.2 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Equipment decontamination and Investigative Derived Waste (IDW) handling are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

Not applicable.

4.0 Equipment and Materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) or other safety equipment, as required by the HASP;
- 55-gallon open-top drums (Department of Transportation [DOT] approved) with lid;

- 55-gallon closed-top drums (DOT approved) for collection of liquids;
- 30-gallon (minimum) garbage bags;
- 5-10 gallon carboys to be used as satellite waste collection containers;
- Type I or II UL approved galvanized steel can(s) to be used for solvent waste collection;
- 5-gallon buckets with lids;
- permanent marking pens and/or paint pens;
- labels and tags;
- duct tape;
- storage racks;
- small (cooler-size) storage containers;
- walk-in cooler;
- chemical storage cabinet (meeting Occupational Safety and Health Administration [OSHA] and National Fire Protection Association [NFPA] Code 30 specifications/Factory Manual [FM] approved);
- field logbook and IDW log form (see Attachment 1); and
- Acid and solvent spill kits.

5.0 Procedures

Potentially contaminated sediment, water, PPE, and other materials will be classified into three categories: (1) solid materials consisting of sediments, sediment samples returned from the laboratory, used polybutyrate core tubes, used PPE, and other materials used in the handling, processing, and storage of sediment (addressed in Section 5.1); (2) liquid wastes such as waste water, river water and decontamination water (addressed in Section 5.2.1); and (3) spent and residual chemicals (liquids) from decontamination (addressed in Section 5.2.2). Sediment from cores that are not processed for chemical, biological, or radiochemical analysis may be either archived or disposed of, and will be segregated and handled separately according to its classification. To the extent practical, liquids generated during coring and core processing operations will be separated from the solid material. Each type of material will be handled in the manner described in this SOP.

As discussed in the HASP, solid and liquid IDW handling will be performed in a well ventilated area (in the field) or in the vacuum hood when working in the field facility. Furthermore, skin and eyes will be protected from accidental exposure. Liquid IDW transfers will also take place in a well-ventilated storage location and may require respirators as specified in the HASP.

5.1 Solid waste

Solid residuals generated during field activities will be characterized for appropriate offsite disposal. Solid residuals consist of two types of materials: non-sediment solid materials generated during the collection and processing of cores, including items such as used polybutyrate core tubes, aluminum foil from clean core tubes, PPE (e.g., gloves, Tyvek® suits, boot covers), and sediment not used for analyses (e.g., waste sediment such as that collected from the core "smear zone" and residual sediment). Non-sediment and sediment wastes will be segregated and temporarily stored in separate containers pending disposal. Loose sediment will be removed from non-sediment waste items prior to disposal and stored with other sediment wastes.

If recovered sediment is determined to be unusable after a core has been cut open, the sediment will be removed from the core tube and stored in an appropriate container for disposal as waste sediment. The used core tube will be stored and disposed of with the non-sediment solid wastes. Sediment residuals will be placed in 55-gallon drums, labeled, and stored temporarily until disposal.

Non-sediment solid materials will be placed in 55-gallon drums, bulk bags and/or a roll-off container, and stored temporarily pending characterization and off site disposal. All drums and bags containing solids residuals will be labeled and handled as described in Section 5.1.1 of this SOP.

5.1.1 Handling and tracking

As they are generated during field activities, waste sediment and other solid waste materials will be placed in DOT-approved 55-gallon drums or 30-gallon bags. Solid waste materials which are initially placed in bags may be bulked into 55-gallon drums for storage. The following procedures will be followed for storing sediment and other solid waste in these drums:

- A unique drum number (consisting of the program ID and the sequential number) will be assigned to each drum by the Field Task Manager or designee. The drum number will be clearly marked on multiple places on the drum;
- A label indicating that the drum contains IDW pending characterization and a Class 9 Hazardous Solid Waste label will be placed on each drum;
- A log will be kept for each drum, listing the materials placed in that drum. All solid materials will be segregated based on the type of material (e.g., sediment, coring tubes, PPE, waste plastic, paper, or foil) and, to the extent practicable, by where they were generated (e.g., location within the river, station number, etc.);
- Drums will be kept closed at all times except when material is being added to them. Drums will be sealed (bungs or lid bands tightened) when not in active use.
- Collection drums may be reused at the processing facility after emptying; and
- Drums containing solid materials will be stored in a secured area within the field facility until proper offsite disposal can be coordinated. Drums containing hazardous waste will be removed from the facility within the time mandated for the governing hazardous waste generator status (large quantity generator, small quantity generator, or conditionally except generator).

5.2 Liquid waste

5.2.1 Waste water

Waste water will be generated during sediment core processing and decontamination activities. Sediment recovered during this process will be handled according to Section 5.1 of this SOP. Waste water will be collected in the large on-site storage tank (which is connected to the sink outlet) until the material is characterized and transferred off site for disposal.

5.2.2 River water

River water will be generated during the collection of surface water samples including purging the pump tubing and excess water retained in the trigger-activated grab sampler. River water is not considered IDW. During sampling activities, river water that is collected during the sampling but is not needed to fill the required sample containers will be temporarily containerized in 5-gallon plastic buckets, and will be returned to the river upon completion of sampling at a station.

5.2.3 Chemical liquid wastes

Chemical liquid wastes will include the spent solvents and acids and other residual chemicals generated during the decontamination process (refer to SOP LPR-G-03 – Equipment Decontamination).

Waste acids and solvents will be collected in (dedicated) satellite containers as follows:

- Waste acids (e.g., HCl, HNO_3) will be collected in a plastic storage carboy (20-L) SEPARATE FROM WASTE SOLVENTS, labeled with a Class 8 Corrosive Liquid label and containing a tag that indicates acid name, concentration, and volume along with users initials, date/time.
- Waste solvents (e.g., acetone, methanol and hexane) will be collected in Type I or II UL approved galvanized steel disposal can, SEPARATE FROM WASTE ACIDS, labeled with a Class 3 Flammable Liquid label and containing a tag that indicates solvent name, concentration, and volume along with users' initials, date/time.

If chemical liquid waste volumes increase beyond limited satellite storage container capacity, they will be placed in separate DOT-approved 55-gallon drums as follows:

<u>Acid Waste (HCl, HNO_3):</u>

- Assign a unique identification number to the (plastic lined) acid drum (clearly marked on the top and sides).
- Place a label indicating that the drum contains IDW pending characterization and a Class 8 Corrosive Liquid label on the drum
- Prepare a log for the drum, listing the volume and concentration of each acid transferred to the drum along with date/time.
- Close the drum after each transfer
- Store the drum in a secure area at the field facility until pickup by an authorized waste handler at the end of the field phase. Drums containing hazardous waste will be removed from the facility within the time mandated for the applicable hazardous waste

generator status (large quantity generator, small quantity generator, or conditionally except generator).

Solvent Waste (Acetone, Methanol, Hexane):

- Assign a unique identification number to the Type I or II UL approved steel disposal can (clearly marked on the top and sides);
- Prepare a log for the drum, listing the volume and concentration of each solvent transferred to the drum along with date/time.
- Place a label indicating that the drum contains IDW pending characterization and a Class 3 Flammable Liquid label on the drum.
- Close the drum after each transfer.
- Store the drum in a secure area at the field facility until pickup by an authorized waste handler at the end of the field phase. Drums containing hazardous waste will be removed from the facility within the time mandated for the governing hazardous waste generator status (large quantity generator, small quantity generator, or conditionally except generator).

5.3 Samples returned from offsite laboratories

Upon completion of the required chemical, biological, and/or radiochemical analyses, remaining sample material and sample containers from the laboratory may be returned to the field facility. Returned sample material/containers will be transported under chain of custody procedures, and remain in custody until disposal. Upon receipt, the chain of custody form will be signed and the samples will be logged in by a project staff member. The approximate volume of sample material and the condition of the containers in which the samples are returned will be checked and recorded in the IDW logbook.

The labels will then be removed from the sample containers, and the containers with their contents will be placed in a DOT-approved 55-gallon drum and will be characterized and disposed of off-site.

5.4 Materials returned from sampling locations

Both solid and liquid IDW will be generated at each sediment sampling location. These materials will be containerized in closed 5-gallon buckets on the sampling vessel, labeled, and secured for transport to the CPG field facility dock. The containers will be carried by hand to a truck with a plastic-lined cargo area and then transported to the field facility for consolidation in 55-gallon drums for subsequent testing and disposal.

IDW associated with surface water sampling may include liquid wastes (equipment decontamination solutions) and solid waste such as used PPE, aluminum foil, and tubing. These materials will be containerized as described above and returned to the CPG field facility for disposal. As discussed in Section 5.2, river water is not considered IDW and will be returned to the river upon departure from a sampling location.

6.0 Quality Assurance/Quality Control

6.1 Disposal procedures will be documented in a logbook to ensure that disposal activities are conducted in accordance with the procedures outlined in the SOPs. Waste manifests will be obtained for solid and aqueous waste disposal to verify that proper transportation and disposal of these materials has occurred.

6.2 It is the responsibility of the Field Task Manager to periodically check/ensure that the IDW procedures are in conformance with those stated in this SOP and that records are complete and accurate.

7.0 Data and Records Management

7.1 The Field Task Manager or designee is responsible for documenting the handling and/or disposal of containers filled with solids or liquids generated during the LPRRP investigation in accordance with SOP LPR-G-01 (Field Records). In addition, the following information will be included in the logbook (at a minimum):

- Name of person performing residual management or disposal activities;
- Date and time of activity;
- Information coordinating container numbers for drums or bags containing solid materials with sample numbers, core boring numbers, or origin; and
- Information coordinating origin of waste liquid (water or chemical[s]) with specific waste drum or tank.

7.2 The IDW logbook will be kept at the CPG field facility for the duration of the field program. The logbook will be divided into 3 sections. Section 1 will provide a summary of each drum number, the date that filling commenced, date filled, pickup date, and manifest identifier. Individual drum/container logs (Attachment 2) will be inserted into Section 2 of the logbook when complete (when each container is filled and closed for shipping). All shipping manifest documentation and Land Disposal Restriction forms (if applicable) will be inserted into Section 3 of the logbook when available.

7.3 Deviations to the procedures detailed in the SOP will be recorded in the field logbook at the time of the occurrence and summarized on the Daily Activity Log (refer to SOP LRP-G-01 – Field Records). A formal nonconformance report (NCR) will be completed (refer to SOP LRP-G-01 – Field Records) and distributed as specified in the QAPP.

7.4 All records associated with the activities described in this SOP will be ultimately maintained in accordance with the Lower Passaic River Restoration Project Quality Management Plan (AECOM 2009).

8.0 Personnel Qualifications and Training

8.1 The individual executing these procedures will have read, and be familiar with, the requirements of this SOP. Execution of these activities will initially be supervised by more experienced personnel.

8.2 Personnel will also be health and safety trained and certified as specified by the HASP.

9.0 References

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-2007-2009. September 2009 or current version.

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011 or current version.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

Tierra 2007. Standard Operating Procedure No. 7 (Revision 2), Management and Disposal of Residuals. Newark Bay Study Area Phase II RIWP, Appendix F, October, 2007.

10.0 Revision History

Revision Date		Changes
0 April	2008	NA
1	July 2008	Remove “acid” from solvent waste procedures in Section 5.2.2; add destruction of labels to Section 5.3
2	June 2010	Added information specific to surface water sampling; logo change.
3	September 2010	Minor revisions throughout the document.
4	June 2011	Minor revisions throughout the document.
5	July 2011	Included Newark Bay Study Area

Attachment 1 – Example of IDW Log

IDW Log
Lower Passaic River Restoration Project
Remedial Investigation
Project No: 60145884

Task: ________

Drum No.	Volume	Description/Content	Manifest No.	Date	
				Full	Shipped

Standard Operating Procedure
Lower Passaic River Restoration Project

Sample Custody

Procedure Number: LPR-G-05

Revision No.: 6

Revision Date: July 2011

Prepared by

Kristen Durocher
Dion Lewis

Laura Kelmar, AECOM Project Manager — Date: July 7, 2011

Debra L. Simmons, Project QA Manager — Date: July 7, 2011

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Contents

1.0 Scope and Applicability

1.1 The purpose of this document is to define the standard operating procedure (SOP) for the chain-of-custody (COC) procedures associated with samples collected in the Lower Passaic River Study Area and the Newark Bay Study Area as part of the Lower Passaic River Restoration Project (LPRRP). The objective of COC procedures is to provide sufficient evidence of sample integrity to satisfy data defensibility requirements. Samples may include sediment or water collected or generated for chemical, radiochemical, biological, and/or physics analyses, and associated quality assurance (QA) analysis. This SOP is intended to be complete enough so that: 1) the steps which could affect tracking, documentation, or integrity of samples are explained in sufficient detail and 2) different sampling personnel following these procedures will deliver samples to the laboratory which are equally reliable and consistent, and in compliance with regulatory agency requirements.

1.2 It is expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending on field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Task Manager and the Project QA Manager and will be communicated to the Cooperating Parties Group (CPG) Project Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from the SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and Safety Considerations

2.1 Although COC activities do not generally pose significant health and safety risks, sample exposure via external container residues may occur and much of the work going on in the vicinity of sample custodians requires attention to safety practices. Project-related physical, chemical and biological hazards are addressed in the site specific Health and Safety Plan (HASP) and associated addendums (MPI 2005a; MPI 2005b; AECOM 2011).

2.2 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

Not applicable.

4.0 Equipment and Materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by the HASP;
- sample containers as specified in the QAPP (Worksheet #19);
- sample labels;
- chain of custody forms;
- custody tape or seals;
- field logbook;
- ballpoint pen or fine-tipped marked (e.g., Sharpie®); and
- clear plastic sealing tape.

5.0 Procedures

5.1 General requirements

5.1.1 As few people as possible should handle the samples.

5.1.2 Sampling personnel should be able to testify that tampering of the samples could not occur without their knowledge.

5.2 Sample identification

Each sample, including field samples and quality control (QC) samples (e.g., trip blanks, equipment rinsate blanks, field duplicates) will be assigned a unique identification. Refer to the corresponding QAPP (Worksheet #27) for the sample identification protocol.

5.3 Sample labeling

5.3.1 A label will be attached to each bottle used for sampling. Waterproof, adhesive labels are preferred. Labels will be applied to the container, not the lid, whenever possible.

5.3.2 When practical, the project identification, sample matrix, laboratory designation/analyses requested, field sample identification code, and preservation will be typed or printed onto the label before sampling. The label will be protected from water and solvents with clear packing tape, except in cases where not appropriate (for example, pre-weighed VOA vials).

5.3.3 Completion of the sample labels (including the sampler's initials and the date and time of sample collection) will occur at the time of sample collection. Labels will be completed in waterproof, indelible ink.

5.4 Sample tracking

5.4.1 From the time of collection through transportation, the handling of samples will follow COC procedures. A representative from each sampling team (e.g., from each vessel) will be assigned as the field sample custodian. This individual will be responsible for the custody of the samples from collection until release to CPG field facility Sample Management Officer (SMO) for processing or shipment to the laboratories. The field sample custodian will provide a sample transfer/custody form and the completed and electronic versions of the sample collection forms (refer to SOPs LPR-S-01 – Grab Sampling, LPR-S-02 – Sediment Coring Using a Piston Push Core, and LPR-S-03 – Sediment Sampling Using a Vibracorer) to the CPG Field SMO when relinquishing the collected samples for sample processing or shipment. The CPG Field SMO will verify the samples against the sample transfer/custody form and then sign the form accepting custody of the samples. An example sample transfer/custody form for field to CPG facility transfer of sediment cores is provided as Attachment 1; a similar form or a standard chain of custody (COC) form (Attachment 2) may be utilized for other types of samples.

5.4.2 A sample is considered under a person's custody if one or more of the criteria are met:

- sample is in the person's possession;
- sample is in the person's view after being in person's possession;
- sample was in the person's possession and then was locked up to prevent tampering; or
- sample is in a designated secure area.

5.4.3 Samples collected for analysis will be continuously tracked in the CPG field facility and while in transit to the laboratory by use of the following procedures below. The CPG field facility is locked, with limited access, and is therefore considered to be a secure area.

5.4.4 Individual sample bottles will be properly labeled and securely sealed before being placed in the container for shipment to the laboratory.

5.4.5 Pertinent information will be entered on the COC form (Attachment 2) and will include

- project identification (project and task number, LPRRP sampling program);
- signatures of samplers;
- sample identification code. This code should be unique to the sampling event and to the program and must agree exactly with the field sample identification code recorded on the bottle label;
- date and time of sample collection,
- sample matrix (sediment, water, etc.);
- analyses requested;
- number of sample containers;
- preservative;
- grab or composite sample designation (if applicable);

- sampler's remarks (optional). These comments may serve to alert the laboratory to highly contaminated samples or identify QC sample requirements.
- signatures of individuals involved in sample transfer;
- destination (e.g., laboratory name and location);
- page number (for example: 1 of 2, 2 of 2);
- if applicable, COC tape numbers; and
- if applicable, the air bill or other shipping number.

This information is consistent with guidance in SW 846, Test Methods for Evaluating Solid Waste (USEPA, 1993).

5.4.6 The COC will be manually filled out completely and legibly in indelible ink, or reproduced from electronic sample forms produced directly from EQuIS Data Gathering Engine (EDGE)™ software from Earthsoft (refer to SOP LPR-G-01 – Field Records). COCs may be pre-printed with known information (project identification, parameters to be analyzed, etc.). Corrections will be made, if necessary, by drawing a single line through and initialing and dating the error. The correct information will then be recorded with indelible ink. There should be no unexplained blank spaces. Blank lines will be lined out and initialed and dated.

5.4.7 Each COC will be cooler-specific (i.e., list only the samples packed in the cooler). Information on the COC must agree exactly with that recorded on the sample containers. Discrepancies may result in the samples being incorrectly logged into the laboratory or delays in initiating sample analysis.

5.4.8 The completed COC form will be signed, dated, enclosed in a sealable plastic bag, and placed in the container prior to shipment. A copy of the COC will be retained by field personnel and stored in a dedicated binder or file. Additional copies will be distributed via email or fax as follows:

- Project Chemist or his/her designee;
- Data Management Task Manager or his/her designee;
- CPG QA coordinator, and
- laboratory project manager at each laboratory being used.

5.4.9 Samples will be considered in the custody of the field sample custodian or CPG Field SMO while in his/her possession or within sight, or maintained in a secure area prior to shipment. If the person packing the container and verifying the sample list (i.e., the CPG Field SMO) is different than the sampler, and the sample transfer/custody form (see Attachment 1 or equivalent) has been completed, the CPG Field SMO will sign the COC form to relinquish custody. The field sample custodian will sign each COC as the sampler.

5.4.10 If samples are to be shipped by commercial overnight carrier, COC seals must be used and the COC seal numbers recorded on the COC form. See Attachment 3 for an example COC seal. Refer to SOP LPR-G-06 – Packaging and Shipment of Environmental Samples for specific packaging procedures. Representatives of commercial carriers are not required to sign the COC form.

5.4.11 If samples are hand carried to a laboratory, custody will be maintained and documented on the COC form through the process (e.g., from the person packing the cooler to the person transporting the samples to the laboratory).

5.4.12 If samples are transmitted to the laboratory by courier, the procedures described in either Section 5.4.10 or 5.4.11 will be followed, depending on whether the courier is a commercial courier or laboratory representative, and whether the cooler has been secured by COC seals prior to pick up by a laboratory courier.

5.4.13 Upon receipt at the laboratory, the designated laboratory sample custodian will sign the COC form indicating receipt of the incoming field samples. The samples will be checked against the COC form upon arrival at the laboratory. The receiving personnel will enter all arriving samples into the laboratory system. Any discrepancies between the samples and the COC form(s), or any evidence of tampering with the shipping container or the custody seal will be immediately reported to the Project Chemist. The laboratory sample custodian will check the temperature of the cooler upon arrival at the laboratory and record the measured temperature on the COC and/or appropriate sample/cooler receipt forms. The Project Chemist will be immediately notified of any sample preservation issues, including temperature exceedances.

5.4.14 A completed copy of the COC form will be distributed via email or fax to the Project Chemist within 24 hours of sample receipt at the laboratory. The original will be retained by the laboratory.

6.0 Quality Assurance/Quality Control

6.1 Completed COCs will be reviewed by the individuals preparing the samples for shipment for completeness, accuracy, and legibility. Specifically, the samples and COC record will be compared to ensure agreement between the sample labels and the COC, and to verify the number of sample containers.

6.2 These records are subjected to periodic review by the Field Task Manager to verify adherence to the procedures outlined in this SOP.

7.0 Data and Records Management

7.1 The records associated with the custody process (transfer forms, COC records, airbills, etc.) will be maintained at the CPG field facility in an organized and contained manner (e.g., 3-ring binder or file folder) for the duration of the sampling event.

7.2 COC records will be distributed to the appropriate personnel as described in the Lower Passaic River Data Management Plan (DMP; AECOM 2010).

7.3 Deviations to the procedures detailed in the SOP will be recorded in the field logbook at the time of occurrence and summarized on the Daily Activity Log (refer to SOP LRP-G-01 – Field Records). A formal nonconformance report (NCR) will be completed (refer to SOP LRP-G-01 – Field Records) and distributed as specified in the QAPP.

7.4 All records associated with the activities described in this SOP will be ultimately maintained in accordance with the Lower Passaic River Restoration Project Quality Management Plan (AECOM 2009).

8.0 Personnel Qualifications and Training

Individuals executing these procedures will have read and be familiar with the requirements of this SOP and the corresponding LPRRP plans (e.g., HASP, QAPP, DMP). No specialized training is required; however, execution of these activities will initially be supervised by more experienced personnel.

9.0 References

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-207-2009. September 2009 or current version.

AECOM 2010. Lower Passaic River Data Management Plan. July 2010, or current version.

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011 or current version.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

Tierra 2007. Standard Operating Procedure No. 2 (Revision 2), Containers, preservation, handling, and tracking of samples for analysis. Newark Bay Study Area Phase II RIWP, Appendix F, October, 2007.

United States Environmental Protection Agency. 1997. SW 846, Test Methods for Evaluating Solid Waste.

10.0 Revision History

Revision	Date	Changes
0	May 2008	NA
1	July 2008	Changes to Sections 5.3, 5.4.1 and 5.4.8
2	September 2009	Minor changes to address non-sediment samples
3	June 2010	Minor changes to address surface water sampling; organizational changes; update logo

Revision	Date	Changes
4	September 2010	Minor revisions throughout document
5	June 2011	Minor revisions throughout document
6	July 2011	Added Newark Bay Study Area

Attachment 1 Example Grab/Core Field Custody and Transfer Form

Grab/Core Field Custody and Transfer Form

Lower Passaic River Restoration Project, Remedial Investigation

Project No: 60145884

Grab/Core ID	Segment Length (Cores only) (in)		Collection		Storage Conditions[1]		Comments
			Date	Time	Transit	Facility	

[1]Freeze (F) or chill on ice (C)

Relinquished by: (print name/affiliation)	Date:	Received by: (print name/affiliation)	Date:
Signature	Time:	Signature	Time:
Relinquished by: (print name/affiliation)	Date:	Received by: (print name/affiliation)	Date:
Signature	Time:	Signature	Time:
Relinquished by: (print name/affiliation)	Date:	Received by: (print name/affiliation)	Date:
Signature	Time:	Signature	Time:

Attachment 2 Example Chain-of-Custody Form

AECOM

CHAIN OF CUSTODY RECORD

Page ____ of ____

Client/Project Name: **CPG/LPRRP RI LRC/Sediment Sampling**

Project Location: **Lower Passaic River, NJ**

Analysis Requested

Project Number: **60145884**

Field Logbook No.:

Sampler (Print Name)/(Affiliation):

Chain of Custody Tape Nos.:

Signature:

Send Results/Report to: **Marie Wojtas/ENSR**

TAT: **see QAPP**

Container Type
P – Plastic
G – Glass
V – VOA Vial
O – Other
E – Encore

Preservative
1 – HCl
2 – H2SO4
3 – HNO3
4 – NaOH
5 – NaOH/ZnAc
6 – Na2S2O3
7 – Ice
8 – MeOH/DI water/ice

Matrix Codes:
DW – Drinking Water
WW – Wastewater
GW – Groundwater
SW – Surface Water
ST – Storm Water
W – Water

S – Soil
SL – Sludge
SD – Sediment
SO – Solid
A – Air
L – Liquid
P – Product

Field Sample No./Identification	Date*	Time*	COMP	GRAB	Sample Container (Size/Mat'l)	Matrix	Preserv.	Field Filtered											Lab I.D.	Remarks
				√																
				√																
				√																
				√																
				√																
				√																
				√																
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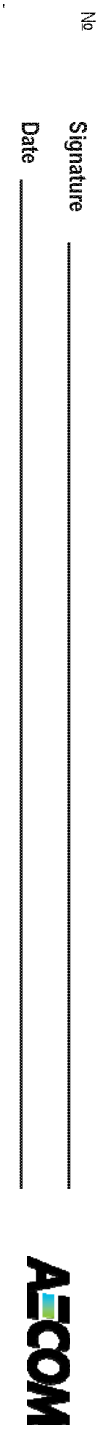
				√																

Relinquished by: (Print Name)/(Affiliation)	Date: / Time:	Received by: (Print Name)/(Affiliation)	Date: / Time:	Analytical Laboratory (Destination):
Signature:		Signature:		
Relinquished by: (Print Name)/(Affiliation)	Date: / Time:	Received by: (Print Name)/(Affiliation)	Date: / Time:	
Signature:		Signature:		
Relinquished by: (Print Name)/(Affiliation)	Date: / Time:	Received by: (Print Name)/(Affiliation)	Date: / Time:	Sample Shipped Via: UPS FedEx Courier Other — Temp blank: Yes No
Signature:		Signature:		

*For sediments, represents the date and time of core/grab collection, not processing

Serial No. ____________

Attachment 3 Example Chain-of-Custody Seal



AECOM

Standard Operating Procedure
Lower Passaic River Restoration Project

Sample Packaging and Shipping

Procedure Number: LPR-G-06

Revision No.: 5

Revision Date: July 2011

Prepared by

Kristen Durocher
Dion Lewis

Laura Kelmar, Project Manager

Date: July 7, 2011

Debra L. Simmons, Project QA Manager

Date: July 7, 2011

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: _____ Date: _____
Initials: _____ Date: _____

Contents

1.0 Scope and Applicability

1.1 The purpose of this document is to define the standard operating procedure (SOP) for packaging and shipping samples collected in the Lower Passaic River Study Area and the Newark Bay Study Area as part of the Lower Passaic River Restoration Project (LPPRP). Sample packaging and shipment generally involves the placement of individual sample containers into a cooler or other similar shipping container and placement of packing materials and coolant in such a manner as to isolate the samples, maintain the required temperature, and to limit the potential for damage to sample containers when the cooler is transported.

1.2 It is expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending on field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by Task Manager and the Project Quality Assurance (QA) Manager and will be communicated to the Cooperating Parties Group (CPG) Project Coordinator and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from the SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and Safety Considerations

2.1 Although packaging activities do not generally pose significant health and safety risks, sample exposure via external container residues may occur and much of the work going on in the vicinity of sample custodians/shippers require attention to safety practices. Project related physical, chemical, and biological hazards are addressed in the site specific Health and Safety Plan (HASP) and associated addendums (MPI 2005a; MPI 2005b; AECOM 2011).

2.2 Sample packaging and shipping involves potential physical hazards primarily associated with handling of occasional broken sample containers and lifting of heavy objects. Adequate precautions will be taken, including minimizing the weight of individual coolers, using hand carts to transport coolers, and using the buddy system to lift coolers into and out of vehicles.

2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

Improper sample storage or inadequate protection against breakage and cross-contamination could potentially affect sample results. The field team will follow the details of this SOP to minimize these effects.

4.0 Equipment and Materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by the HASP;
- inert packing material (e.g., foam peanuts, vermiculite, cardboard, bubblewrap, etc.);
- pre-preserved sample containers as specified in the QAPP (Worksheet #19);
- sample labels;
- chain of custody (COC) forms;
- insulated coolers;
- custody tape or seals;
- indelible marking pens;
- shipping tape;
- sealable plastic bags;
- temperature blanks (provided by the laboratory);
- field logbook;
- ice or similar chilling source;
- ballpoint pen or fine-tipped marked (e.g., Sharpie®); and
- clear plastic sealing tape.

5.0 Procedures

5.1 General requirements

5.1.1 Vehicular sample transport will adhere to normal/applicable Department of Transportation (DOT) regulations and air transport should follow applicable International Air Transport Association (IATA) regulations. DOT and IATA regulations/guidelines related to sample shipments can be viewed on AECOM's SH&E intranet web page.

5.1.2 An area for storing unused sample containers/coolers and a clean area for sample handling, packaging, and shipment will be designated at the CPG field facility to avoid cross contamination concerns.

5.1.3 Laboratories will often re-use coolers. The interior and exterior of each cooler received at a project location should be inspected for cleanliness before using it. Any coolers that have cracked interior or exterior linings/panels or hinges should be discarded. Any coolers missing one or both handles should also be discarded if replacement handles (i.e., knotted rope handles) cannot be fashioned in the field.

5.1.4 Excess strapping tape and old shipping labels should be removed. If the cooler interior exhibits visible contamination or odors it should be decontaminated in accordance with LPR-G-03 – Equipment Decontamination (Level II) prior to use.

5.1.5 The Field Task Manager or designee will notify the laboratory(ies) of the number, type and approximate collection and shipment dates for the samples in advance of any sample transfers and communicate any delays in sample shipment. The laboratory will be alerted when shipments are scheduled for weekend delivery, so that personnel are available to receive the samples.

5.2 Sample packaging and shipping will be done in accordance with applicable regulations, as described below:

5.2.1 After filling a sample container, affix cap and securely seal with clear tape **(except for samples to be analyzed for volatile organic compounds [VOCs])** and complete the sample label. Apply the label to the sample container and cover with clear tape.

5.2.2 Clean the outside of each sample container by wiping it off with a clean paper towel. Verify that residual sediment has been removed from the outside of the container, and from the area under and around the cap.

5.2.3 Place each glass sample bottle into an individual bubble bag sleeve provided by the lab or wrap each glass bottle/jar individually using bubble wrap secured with tape or rubber bands

5.2.4 Seal each sample container inside a sealable plastic bag. Samples for VOC analysis will be packaged together in a sealed plastic bag.

5.2.5 For those samples that require thermal preservation, place on ice or similar chilling source immediately after collection.

5.2.6 Place plastic bubble wrap matting in the bottom of each cooler or shipping container as needed. Insert a clean trash bag into the cooler to serve as a liner.

5.2.7 Transfer the samples to the plastic-lined cooler. Place bottles upright into the cooler. If a combination of plastic and glass sample containers are to be packed, alternate them within the cooler to further protect the glass. Use inert packaging material (e.g., cardboard, vermiculite, etc.) to cushion the samples and minimize the potential for breakage by placing additional packing material throughout the voids between sample containers and between any layers within each cooler to a level which meets the approximate top of the sample containers. Packing material may require tamping by hand to reduce the potential for settling. Seal the drains on the ice chest (if present) with shipping tape or plug the drains with silicone sealant or a similar inert substance.

5.2.8 Place a trip blank in each cooler containing field samples for VOCs and/or TPH Purgeables analyses. It is suggested that sample containers used for VOC or TPH Purgeables analyses should be grouped together into a single individual cooler to limit the number of trip blanks required for transportation and analysis. Note that trip blanks are not required for aqueous QC samples such as equipment rinsate blanks.

5.2.9 Conduct an inventory of sample numbers, fractions and containers when placing samples into the coolers, and check the inventory against the corresponding COC form before sealing the cooler.

5.2.10 For those samples requiring thermal preservation, ice or similar chilling sources sufficient to maintain a temperature of 4° ± 2° Celsius (°C) will be placed inside the cooler during transport. Double bag cubed ice in heavy duty Ziploc type plastic bags to prevent leakage, close the bags, and distribute the packages in a layer over the top of the samples. If sample bottles are bubble wrapped, it is also permissible to insert double bagged ice packages between the sample bottles. Never place un-bagged loose ice directly into a cooler. Use sufficient ice to accommodate reasonable delays in shipment. A temperature blank provided by the analytical laboratory with each cooler will be included in the shipment.

5.2.11 Obtain two custody seals and enter the seal numbers on the COC form. Complete sample tracking documentation as described in SOP LPR-G-05 (Sample Custody), and place the documents in a sealable plastic bag inside the ice chest, taped to the inside of the lid.

5.2.12 Close the trash bag liner to prevent materials from spilling out. Secure chest lid with shipping tape by covering the entire seal with tape. Sign and date the two custody seals, affix the custody seals on opposing corners of the cooler lid and cover the seals with clear plastic tape. An example of a custody seal is attached to SOP LPR-G-05 (Sample Custody).

5.2.13 Shipping containers should be marked "THIS END UP", along with arrow labels which indicate the proper position of the container. Labels used in the shipment of hazardous materials (e.g. Cargo Only Air Craft, Flammable Solids, etc.) are NOT permitted to be on the outside of containers used to transport environmental samples.

5.2.14 Repeat the above steps for each cooler or shipping container. If more than one cooler is being delivered to a laboratory, mark each cooler as "1 of 2", "2 of 2", etc.

5.2.15 Transport the shipping container directly to the laboratory, the laboratory courier, or to the overnight carrier for overnight delivery. Samples will be shipped by close of the same day, whenever possible.

6.0 Quality Assurance/Quality Control

6.1 Completed COCs will be reviewed by the individuals preparing the samples for shipment for completeness, accuracy, and legibility. Specifically, the samples and COC record will be compared to ensure agreement between the sample labels and the COC, and to verify the number of sample containers.

6.2 The laboratory will notify the Project Chemist within 24 hours of receipt in the event that samples are received broken, that there are sample preservation or holding time exceedances, or there are discrepancies between the custody paperwork and the sample containers.

6.3 The procedures and records associated with sample packaging and shipping are subjected to periodic inspection and review by the Field Task Manager to verify adherence to the procedures outlined in this SOP.

7.0 Data and Records Management

7.1 The records associated with the shipment process (COC records, airbills, etc.) will be maintained in the CPG field facility in an organized and contained manner (e.g., 3-ring binder or file folder) for the duration of the sampling event.

7.2 COC records will be distributed to the appropriate personnel as described in the Lower Passaic River Data Management Plan (DMP; AECOM 2010).

7.3 Deviations to the procedures detailed in the SOP will be recorded in the field logbook at the time of occurrence and summarized on the Daily Activity Log (refer to SOP LRP-G-01 – Field Records). A formal nonconformance report (NCR) will be completed (refer to SOP LRP-G-01 – Field Records) and distributed as specified in the QAPP.

7.4 All records associated with the activities described in this SOP will be ultimately maintained in accordance with the Lower Passaic River Quality Management Plan (AECOM, 2009).

8.0 Personnel qualifications and training

Individuals executing these procedures will have read and be familiar with the requirements of this SOP and the corresponding LPRRP plans (e.g., HASP, QAPP, DMP, FSP). No specialized training is required; however, execution of these activities will initially be supervised by more experienced personnel.

9.0 References

AECOM 2009. Quality Management Plan, Lower Passaic River Restoration Project, CERCLA Docket No. 02-2007-2009. September 2009 or current version.

AECOM 2010. Lower Passaic River Data Management Plan. July 2010 or current version.

AECOM 2011. Lower Passaic River Restoration Project, Remedial Investigation, Health and Safety Plan Addendum. June 2011 or current version.

MPI 2005a. Lower Passaic River Restoration Project Health and Safety Plan. January 2005.

MPI 2005b. Lower Passaic River Restoration Project Health and Safety Plan Final Addendum – Sediment Coring. July 2005.

Tierra 2007. Standard Operating Procedure No. 2 (Revision 2), Containers, preservation, handling, and tracking of samples for analysis. Newark Bay Study Area Phase II RIWP, Appendix F, October, 2007.

10.0 Revision History

Revision	Date	Changes
0	April 2008	NA
1	July 2008	Minor changes to Sections 5.1.5, 5.2.7, and 5.2.12
2	September 2009	Minor changes to Section 5.1.1, 5.2, and 7.3
3	September 2010	Minor revisions throughout the document
4	June 2011	Updates to references
5	July 2011	Include Newark Bay Study Area

Appendix C

Laboratory Standard Operating Procedures and Control Limits

To be provided under separate cover.

Appendix C-1

Laboratory Standard Operating Procedures

Appendix C-2

Laboratory Control Limits